AD-A130 684 ARMY PRISONER POPULATION PREDICTION STUDY (AP3)(U) ARMY CONCEPTS ANALYSIS AGENCY BETHESDA MD R M MILLER ET AL. JUN 83 CAA-SR-83-8 1/2

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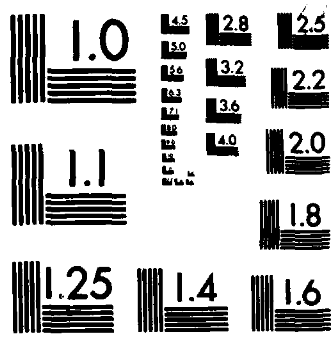

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JUNE 1983

PREPARED BY

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER: CSCA-SR-83-8 (CSCA corrected to CAA by hand)	2. GOVT ACCESSION NO.: AD-A130684	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): Army Prisoner Population Prediction Study (AP3)		5. TYPE OF REPORT & PERIOD COVERED: Final Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): CPT Robert M. Miller; Mr. Stanley H. Miller		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Concepts Analysis Agency, 8120 Woodmont Avenue (ATTN: CSCA-FS), Bethesda, MD 20814		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: Office of the Deputy Chief of Staff for Personnel, Department of the Army (ATTN: DAPE-HRE), Washington, DC 20310		12. REPORT DATE: June 1983
		13. NUMBER OF PAGES: 108
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report): UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

Unlimited

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Active Army; Confinement/correction; Model development; Network analysis; Personnel; Prisoners; Q-GERT; Simulation

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Army Prisoner Population Prediction Study (AP3) consists of the development of a methodology and associated model to provide the Army Correctional System proponent with an analytic managerial tool to assist in the management of the correctional system. The model assesses the impact of various changes in confinement policy decisions and environmental conditions in the criminal justice system on the prison populations. The Army Prisoner Management Model (PRISM) is a network simulation model constructed within the context of Q-GERT.

PRISM simulates the flow of prisoners from the general Army population through the legal court system into correctional/confinement facilities. Various decisions are calculated stochastically to route the prisoners through the network and statistical analyses are performed within the model to report average daily prisoner populations and average confinement times. Military Police crime data and reports, court-martial data, and historical prison data were examined to calculate the rates and probability distributions upon which the model operates. The model was tested and validated by calculation of inputs from historical data and comparing the resulting populations against historical populations.

STUDY REPORT
CAA-SR-83-8

ARMY PRISONER POPULATION PREDICTION STUDY (AP3)

June 1983

Prepared by

FORCE SYSTEMS DIRECTORATE

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REPLY TO
ATTENTION OF

CSCA-FSP 29 June 1983

SUBJECT: Army Prisoner Population Prediction Study (AP3)

Deputy Chief of Staff for Personnel
Department of the Army
ATTN: DAPE-HRE
Washington, DC 20310

1. Reference letter, DAPE, HRE, 13 May 1983, subject as above.

2. Referenced letter directed the US Army Concepts Analysis Agency (CAA) to develop a methodology and model which would provide an analytic capability to assist the Army Correctional System proponent in the management of the system.

3. Attached is the final report which documents our analysis and methodology/model development of the Army Prisoner Management Model (PRISM). This study report discusses the manner in which the study was conducted, the Army criminal justice system, the development of the methodology and the model, and observations resulting from the study. Documentation necessary for operation of the model is included in the appendices.

4. We look forward to seeing an evaluation of this study in accordance with AR 5-5.

5. This Agency expresses appreciation to all commands and agencies who have contributed to this product. Questions and/or inquiries should be directed to the Assistant Director, Force Systems Directorate (ATTN: CSCA-FS), US Army Concepts Analysis Agency, 8120 Woodmont Avenue, Bethesda, Maryland 20814.

David C. Hardison

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DAVID C. HARDISON
Director

[illegible] POPULATION [illegible] STUDY	ONE SHEET STUDY GIST [illegible]

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[illegible] in assessing the impact of [illegible] rates, and various confinement [illegible] correctional system workloads.

[illegible] causing substantial increases or [illegible] in order of greatest impact:

[illegible] the propensity to refer an offender to [illegible] with the offender by non-judicial or [illegible]

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[illegible] non-Army prisoners in Army facilities were not [illegible] the study analysis.

[illegible] of sentences for individual offenses were based [illegible] offense for which an accused was convicted.

[illegible] The study addresses only Army enlisted populations.

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CONTENTS

TABLES

FIGURES

THE ARMY PRISONER POPULATION PREDICTION STUDY (AP3)

CHAPTER 1

INTRODUCTION

1-1. STUDY PURPOSE. The Army Prisoner Population Prediction Study (AP3) develops a methodology and model which simulates expected prisoner workloads on the Army Correctional System (ACS). It is designed to assist the ACS managers in determining expected workloads for planning, programing, and allocating resources efficiently.

1-2. BACKGROUND

a. This study was requested by the Office of Army Law Enforcement as a result of the findings of the Army Correctional System Study (ACSS) and recognition that dynamics were occurring within the ACS causing reactive rather than anticipatory management of the system.

b. CAA was officially tasked by the Office of the Deputy Chief of Staff for Personnel (ODCSPER) to study the ACS and develop analytical tools which would assist the ACS managers in planning, programing, and budgeting resources by determining expected future workloads on the system. The study directive is at Appendix B.

1-3. PROBLEM. The Army prisoner population has significantly increased since 1978. This increase was counterintuitive given such conditions in the Army as increased recruitment of high school graduates and decreasing crime rates. Predictive capability to estimate future prison population workloads is very limited at present, and no model currently exists to assist ACS managers in estimating future prison workloads.

1-4. OBJECTIVES. The objectives of this study are to:

a. Examine the Army criminal justice system and determine those factors which cause changes in prisoner populations within the ACS.

b. Provide analytical results to the study proponent emphasizing those aspects of the criminal justice system which significantly impact upon estimation of prisoner population workloads.

c. Develop and provide a methodology and model to the study proponent which will enable the Army to estimate Army average prisoner populations over the Program Objective Memorandum (POM) years.

d. Provide necessary model documentation to permit operation of the model to allow assessment of planned policy changes on the ACS.

1-5. SCOPE. The study examines the Army criminal justice system with emphasis upon the ACS. It includes assessment of each level of confinement facilities and development of a reliable, valid model to simulate the average prisoner workload for each level of confinement facility. The study also addresses the impact of non-Army prisoners in Army facilities on the ACS.

1-6. LIMITATIONS. Limitations to the study are:

a. The study does not attempt to predict the quantity of non-Army prisoners in Army confinement facilities.

b. The study addresses only enlisted male populations as officer and female prisoners do not represent a significant proportion of the prisoner population from which to draw valid observations and conclusions.

1-7. ASSUMPTIONS. The following assumptions are established in the tasking directive:

a. An all-volunteer force will continue to exist.

b. Current confinement policies will remain in force.

1-8. ESSENTIAL ELEMENTS OF ANALYSIS (EEA). The EEA are:

a. Does the model provide answers to various mangement questions as: how will Army prisoners be distributed among the levels of confinement facilities; what will the workloads be over time; for how long will prisoners be confined?

b. Does the model provide expectations for the ACS 1 to 3 years into the future?

c. Is the model adaptive to such changes in the system as crime rates, sentence lengths, and confinement policies?

1-9. CONTENTS OF THE REPORT. The following chapters, supported by appendices, present the results of this study. Chapter 2 contains a discussion of the Army criminal justice system in general, emphasizing those aspects which directly impact on this study. Chapter 3 discusses the study methodology, while Chapters 4 and 5 detail the model design, validation, operation, and application. Chapter 6 completes the report with observations about the study and possible alternative approaches for future consideration.

CHAPTER 2

THE ARMY CRIMINAL JUSTICE SYSTEM

2-1. INTRODUCTION

a. In order to understand the flow of offenders into and out of the Army's prison system, it was necessary to become familiar with the operation of the Army criminal justice system. Of particular interest were the commission of offenses, referral to trial, sentencing, and incarceration as well as policies and trends affecting these aspects of the system. Only those portions of the Army criminal justice system that impact on this study were examined in depth and are briefly related in this chapter.

b. For the purposes of analysis, the Army criminal justice system was broken down into three subsets: offenses, courts, and corrections, as shown in Figure 2-1.

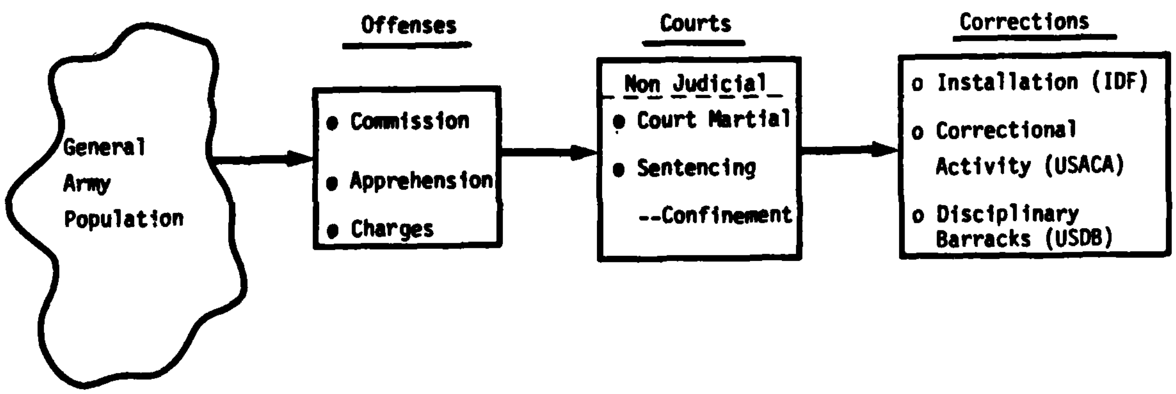

Figure 2-1. Army Criminal Justice System

(1) The offenses block contains aspects to be modeled that pertain to those functions normally associated with the individual, military police, and commanders, i.e., commission of an offense, apprehension of the individual, preferring of charges, and referral to trial.

(2) The courts block represents the legal processing of the individual offender. Although the model is not directly concerned with nonjudicial actions, it is represented as a filtering factor for offenders to reach a level of court-martial. The primary interest of this block is the sentencing to confinement resulting from court-martial action.

(3) Finally, the corrections portion represents incarceration, the type confinement facility, and the length of sentences for offenders. It includes "good time" accrual and clemency actions which impact upon the actual time served in confinement.

2-2. THE ARMY LEGAL SYSTEM

a. Analysis of the Army legal system is beyond the scope of this study. It is sufficient to state that the Army legal system is similar, in most aspects of trial and appellate review processes, to federal and civilian court systems. This study focuses on the trial process as regards referrals to trial and sentencing to confinement for those offenders found guilty.

b. The Army court system is comprised of three levels of court-martial below appellate review: summary courts, special courts-martial, and general courts-martial.

(1) The summary court-martial is the lowest level of court at which an accused may be tried. Since there may be some limitations on the rights of the accused at this level, trial by summary court may be refused by the accused and he may be referred to a higher court. A summary court-martial may not impose any sentence to confinement in excess of 30 days.

(2) The special court-martial is the next higher level court-martial. There are basically two types of special court--the special court-martial (SPCM) and the special court-martial empowered to adjudge a bad conduct discharge (SPCM-BCD). The major difference is that the latter has been empowered by the general court-martial convening authority to adjudge a bad conduct discharge in addition to the special court-martial maximum allowable punishments. The special court-martial can impose a maximum sentence to confinement of 6 months.

(3) The highest level of court-martial, below appellate review courts, is the general court-martial. This court is empowered to impose punishments not to exceed the maximum allowable punishment for the offense charged as specified in the Manual for Courts-Martial (MCM), United States, 1969 (revised edition).

c. Table 2-1 depicts the levels of military justice and the maximum sentence to confinement which each can impose.

Table 2-1. Maximum Sentences to Confinement

Level of action	Sentence to confinement
Nonjudicial	No confinement allowed
Summary court-martial	≤ 30 days confinement
Special court-martial	≤ 6 months confinement
Special court-martial-BCD	≤ 6 months confinement
General court-martial	Max allowed for convicted offense(s)

d. There are features of the sentencing process in the military courts which impact upon any analysis of the criminal justice system. An alleged offender will, in most cases, be tried for more than a single charge and specification. The sentence, however, will be adjudged based on all charges and specifications for which the defendant was found guilty. The sentence is then imposed as a single sentence from which disaggregation to determine how much of the sentence was awarded for a particular charge is nearly impossible. The treatment to determine expectations of sentencing awarded by a specific level of court-martial for a particular set of charges is to use the most confining offense as the determinant.

2-3. THE ARMY CORRECTIONAL SYSTEM

a. General. The Army Correctional System (ACS) is that organizational system within the Army designed to assist commanders at all levels in maintaining unit discipline and strength and to promote law and order through participation as an integral part of the military justice system. The Deputy Chief of Staff for Personnel (DCSPER) has Department of the Army Staff responsibility for policies and procedures concerning the Army Correctional System, and provides Army-wide guidance and assistance in those matters. The Army Correctional System consists of Army confinement facilities, Army correctional facilities, and hospitalized prisoner wards. Army correctional facilities are the United States Army Correctional Activity (USACA) and the United States Disciplinary Barracks (USDB).

b. Confinement/Correctional Facilities. Since 1972, Army compliance with the Military Correctional Facilities Act has been the consolidation of post-trial confinement at the USDB, FT Leavenworth, Kansas and the US Army Correctional Activity (USACA), FT Riley, Kansas. Pre-trial confinement is the responsibility of the individual installation commanders and is performed at the local/regional installation detention facilities (IDF).

(1) Installation Detention Facilities. There are currently 12 IDF in CONUS and 6 IDF OCONUS as shown in Table 2-2. In addition to the pre-trial confinement missions, the IDF now have a post-trial mission to confine prisoners with a sentence of 30 days or less. The organization of a typical Installation Detention Facility is shown in Figure 2-2.

Table 2-2. US Army Confinement Facilities

Facility	Operating capacity
CONUS	
FT Benning	62
FT Campbell	60
FT Carson	62
FT Gordon	60
FT Hood	100
FT Knox	50
FT Lewis	50
FT Meade	57
FT Ord	100
FT Polk	34
FT Riley	96
FT Sill	43
Total	774
OCONUS	
FT Clayton	13
FT Richardson	25
Berlin	1
Mannheim	156
SETAF	4
Eighth Army	50
Total	249
Confinement total	1,023

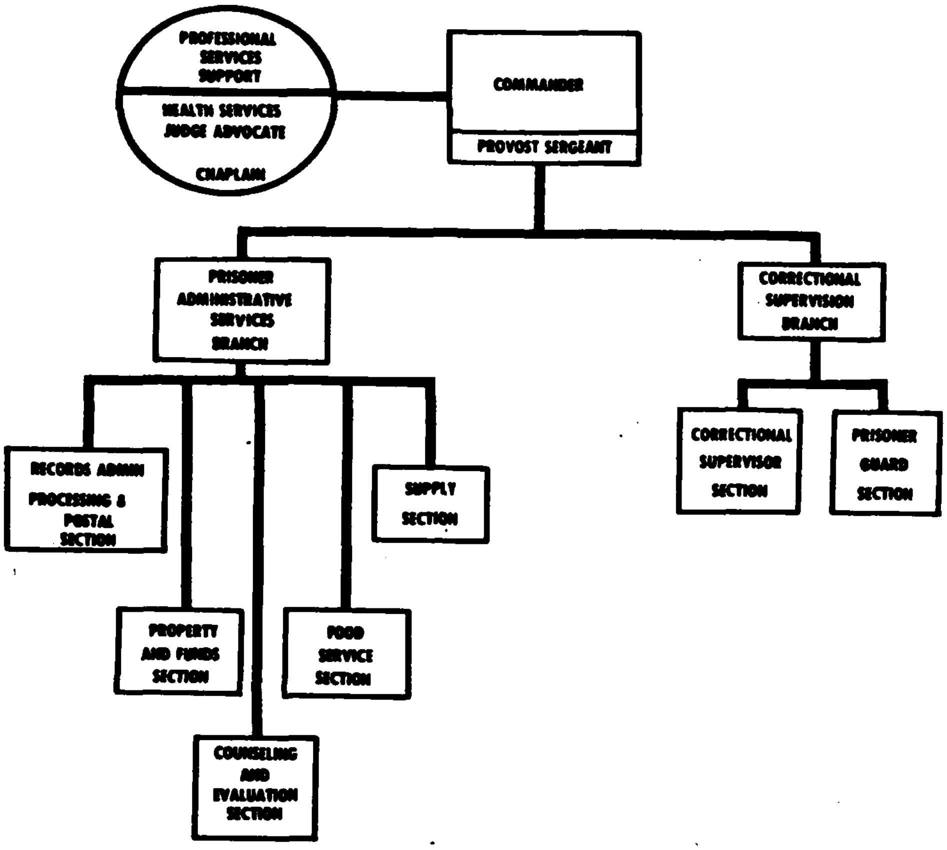

Figure 2-2. United States Army Confinement Facility Organization

(2) US Army Correctional Activity. USACA located at FT Riley, Kansas is one of the two Army correctional facilities. USACA provides specialized training programs, professional evaluation, and counseling necessary to prepare all assigned and attached trainees (former prisoners) for continued military duty or return to civilian life. Further, the USACA provides custodial supervision and care for those prisoners in a confined status prior to release to training or other disposition. The post-trial confinement mission of USACA currently includes all prisoners with a sentence to confinement of 31 days to 1 year. The organization of USACA is shown in Figure 2-3.

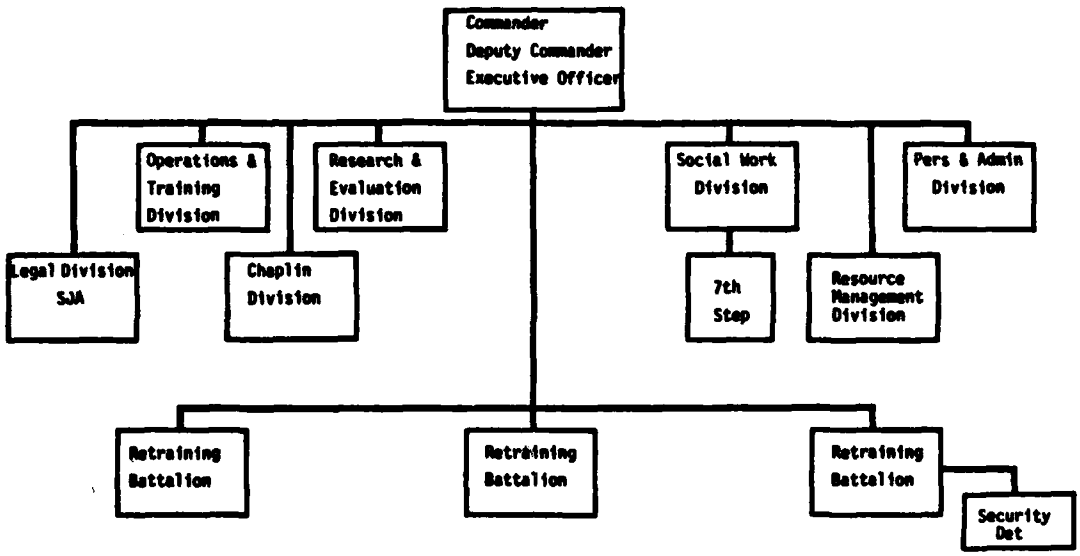

Figure 2-3. United States Army Correctional Activity Organization

(3) <u>United States Disciplinary Barracks</u>. The USDB at FT Leavenworth, Kansas is the second of the two Army correctional facilities. The USDB provides specialized correctional programs, professional evaluation, counseling, training, and custody to prepare military prisoners for return to military duty or to the civilian community. The USDB currently has the mission to provide such support for all prisoners with a sentence to confinement in excess of 1 year. The organization of the USDB is shown in Figure 2-4.

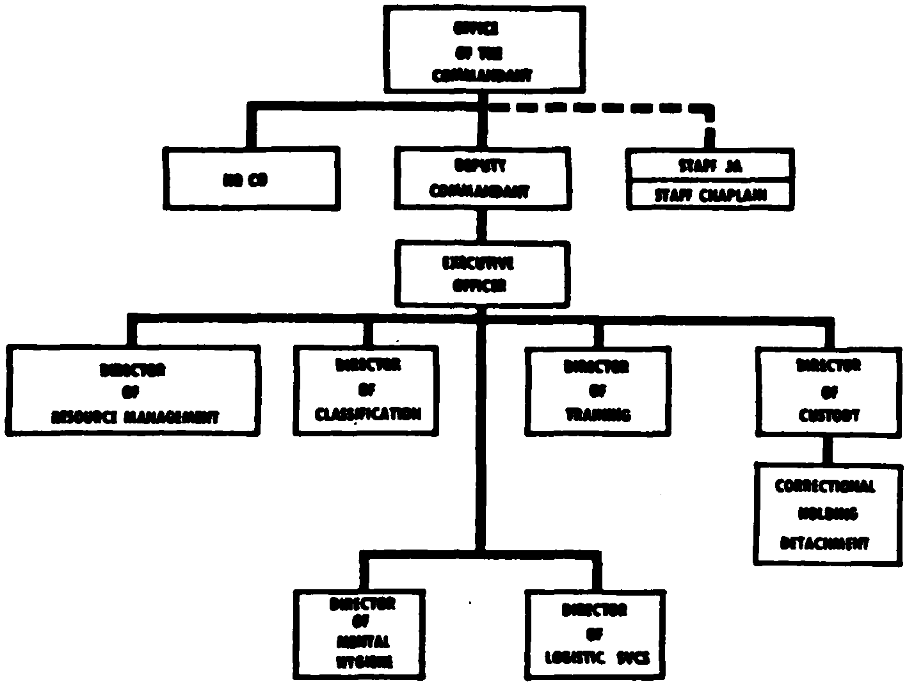

Figure 2-4. United States Diciplinary Barracks Organization

c. Confinement Policies. The confinement policies for the Army Correctional System are fully outlined and explained in AR 190-47. The following policies impact upon the flow of prisoners into, through, and out of the correctional system.

(1) Periodically the Army Correctional System managers adjust the sentence prerequisite for assignment of prisoners to the various levels of confinement. Current policy states that prisoners with a sentence of 30 days or less will be confined at the local IDF; prisoners with a sentence of 31 days to 1 year will be confined at the USACA; prisoners with a sentence to confinement in excess of 1 year will be confined at the USDB.

(2) Other policies which impact upon the flow of prisoners through the system concern the accrual of good conduct time or work abatements to prisoner sentences as well as parole/clemency board actions. These policies have the effect of reducing sentence lengths and consequently the numbers of prisoners in confinement/correctional facilities at any particular time.

2-4. SUMMARY. The emphasis in this chapter was to highlight those elements which are of major importance in understanding the portions of the system to be modeled and those factors of the system which have major impact on the modeling effort.

a. Offense commission rates.

b. Probabilities of court-martial given an offense.

c. Probability and the distributions of sentences to confinement given a court-martial.

d. Given a sentence, the level of confinement facility at which confinement will be served.

e. The lessening of an approved sentence through established confinement policies.

Each of these factors will be further discussed in greater detail in Chapter 4 within the context of the model development.

CHAPTER 3

STUDY METHODOLOGY

3-1. INTRODUCTION. This chapter describes the methodology employed and general tasks performed during the conduct of the Army Prisoner Population Prediction Study. The methodology will be described in terms of three major phases: background, development, and validation. The various tasks which occurred during these phases will then be described.

3-2. THE METHODOLOGY OF THE STUDY. The background phase provided the study team with a working knowledge of the military criminal justice system and the policies and procedures of the Army Correctional System. Further, the study team became familiar with available data and data sources, existing methodologies, and tools and techniques for model and methodology development. During the development phase, relevant data were selected, tools and techniques were used to manipulate the data, and the prisoner flow/decision network methodology and model were developed. Test data were input to the model to ensure the functioning of the model and the validity of the methodology. During the validation phase, output from the model was analyzed to determine how well the model reflected "real-life," given that inputs were calculated from historical data.

a. Background Phase. The four tasks of the background phase are described below.

(1) The first task of this phase was accomplished through a search of the literature pertaining to the Army Correctional System and both military and civilian criminal justice systems. A detailed examination of current regulatory guidance and reviews of reports by other analytical agencies provided the basic knowledge which was augmented by interviews with personnel who were knowledgeable in both the military legal system and the Army Correctional System policies and procedures. With this information, the study team was able to describe, in detail, the processes by which soldiers flow from the commission of an offense, through the legal processes, into and out of the Army correctional/confinement facilities.

(2) The second task was to identify data sources, collect data, and to determine the relevancy of the data to the study. The primary sources of data used in the development of model input were the automated files of The Judge Advocate General (TJAG) of the Army and the reports and historical data from the Office of Army Law Enforcement, the US Army Correctional Activity (USACA), and the US Disciplinary Barracks (USDB). These data included rates at which various offenses are committed, the individuals tried at various levels of court-martial, sentencing data, and data concerning prisoner populations.

(3) The third task was to determine what, if any, Army models and methodologies were in use to forecast or estimate future prisoner workloads on the Army Correctional System, their output, and relationship to this study. The study team established that other than limited collection of data, no substantial analysis was employed to make the necessary estimates. The principal methodology being used was the application of expert judgment and correctional system experience. It was, therefore, devolved upon the study team to develop the methodology and model to permit an analytical estimation of prisoner workloads for the management of the Army Correctional System.

(4) The last task was to review and select analytic tools and techniques for use in the study. The effort focused upon those analytic tools and techniques that could (1) provide the information necessary to manage the Army Correctional System and (2) prepare the available data for use in the developed methodology and model. The Q-GERT simulation language was the technique selected to model the prisoner network system and a variety of statistical analysis tools were used to operate on the data to develop the input and test the output. Q-GERT was selected because it is a procedural network technique which simulates sequential, time-phased activities and is extremely flexible to problem formulation. The primary statistical analytical tools were regression analysis and distribution hypothesis testing for calculation of input rates and sentence distributions.

b. Development Phase. This phase provided for the development of the prisoner network methodology and model, the development of the rates and probability distributions for sentencing criteria, and the testing of the model.

(1) The first task was to build the network of the criminal justice system as it pertains to the flow of prisoners into the Army Correctional System. The modeling tool applied was Q-GERT, an introductory explanation of which is provided at Appendix D. This task involved graphically representing each activity and decision point to route offenders into or out of the Army Correctional System. The actual methodology and model development is more fully explained in Chapter 4.

(2) The next task was to develop the necessary rates and probability distributions upon which offenders would be generated and decisions would be made concerning the trial and sentencing of the offenders. This task was accomplished by applying regression and heuristic analysis to the data obtained from the Office of Army Law Enforcement to determine the commission rates of various offenses. The Army law enforcement managers do not report or collect significant data concerning lesser military-type offenses such as disrespect and disobedience. The rates for these offenses were calculated from court-martial data provided by the US Army Legal Services Agency (USALSA). The data provided by USALSA

were also the primary source for the determination of sentencing probability distributions. These data were examined and probability distributions were hypothesized. The hypotheses were tested to see if they could be rejected. When a distribution was selected, then the parameters of that distribution were used for stochastic awarding of a sentence to the offender for that particular offense.

(3) The final task in the development phase was to control the input data and test the methodology/model to ensure that the prisoner flow was occurring in the manner for which the model was developed.

c. Validation Phase. In this phase the model output was examined to ensure that the model operation and input were such that "real life" was accurately reflected. Input rates and sentencing criteria were drawn from historical data and the model output was compared to the actual prison populations resulting during those years. Further, these rates and criteria were varied (increased and decreased) such that the study team was assured that input of a range of sentencing criteria and offense commission rates resulted in a range of expected prisoner populations which would permit a more analytical management of the Army Correctional System.

3-3. ANALYTIC TOOLS AND TECHNIQUES. The tools and techniques used in the Army Prisoner Population Prediction Study are as mentioned in paragraph 3-2. Program routines and the Q-GERT model have been provided, in automated form, to the Office of Army Law Enforcement for their use. These programs and routines are included at Appendix F. An introductory explanation of Q-GERT and the model is provided at Appendix D, and user documentation is provided in Appendix E.

3-4. QUALITY ASSURANCE. Quality assurance of the study product was achieved through continuous close coordination with knowledgeable and experienced personnel at the Military Police Operations Agency, the US Army Legal Services Agency, and the Research and Evaluation Division of the US Army Correctional Activity. As concepts were developed and data analyzed during the study, discussions were held with appropriate points of contact to ensure accuracy, consistency, and compliance with current policies and procedures. Technical assistance was obtained from the Mathematics/Statistics Team, Analysis Support Directorate of the US Army Concepts Analysis Agency in the statistical development of the model input. In-process review briefings were provided to the CAA Analysis Review Board and to the study sponsor's representative to ensure utilization of sound techniques and study procedures, and compliances with the study directive. In addition, the CAA Product Review Board reviewed the study product prior to publication.

CHAPTER 4

METHODOLOGY/MODEL DESIGN

4-1. INTRODUCTION. The Army Prisoner Population Prediction Study resulted in the development of two main products: (1) a methodology, and (2) a model. The methodology is the conceptualization of the process whereby the criminal justice system can be described graphically and analytically for that portion of the system which impacts on the Army Correctional System. The model puts the concepts of the methodology into operation. The model developed for this study is the Army Prisoner Management Model (PRISM). It was designed to allow ease of operation and flexibility in changing model parameters which will, in turn, give the Army Correctional System (ACS) managers analytical results of policy decisions under consideration.

4-2. DESIGN CONSIDERATIONS. In the development of the methodology/model, many factors had to be considered. Most important were the desires of the study sponsor concerning the questions which must be addressed by the model and the problems in the management of the Army Correctional System which the model/methodology should be able to assist in resolving. Additionally, there were technical considerations which impacted on the development.

a. Background. Interviews with personnel from the Office of Army Law Enforcement yielded the desires of the sponsor regarding the model/methodology output and capabilities. Currently, the Army reacts to overcrowding crises rather than being able to anticipate potential overcrowding. Thus, it was necessary that the study products provide the capability to reflect the effects on future prisoner workloads of changing trends as crime rates and court-martial rates. The sponsor also needed a capability to determine the distribution of prisoners over the various levels of confinement and the sentence lengths for which they would be confined. This information would enable the ACS managers to make confinement policy decisions to prevent potential overcrowding at any particular facility.

b. Technical Consideration. The task of the study team in developing a system model led to several technical aspects which needed to be considered during development. The system is a procedural system which is subject to change due to policy decisions and varying offense rates. It therefore lends itself well to network type modeling design. The entire criminal justice system needed to be included in the design structure for those portions pertaining to the determination of sentences and sentence lengths. The overall system design had to be structured to select offenders from the general Army population, refer them to trial, sentence them if found guilty, and have them serve their confinement. The serving of a sentence was further complicated by clemency and parole board actions as well as by accrual of good conduct abatements.

Further, the model is to be operated by personnel who are not trained analysts; therefore, the model must be relatively easy to operate.

c. Summary. The above considerations could all be applied using Q-GERT which is a procedural networking technique modeling sequenced, time-phased activities in a stochastic manner. It has the capability to model diverse systems and act as a communications/information analysis tool which is extremely flexible to problem formulation. Q-GERT, therefore, was selected to be the tool with which the model/methodology development would be conducted.

4-3. Q-GERT

a. What Is Q-GERT? Q-GERT is an analytical tool that has been developed to provide a capability to model complex network systems and apply computer analysis to such systems. The name GERT is an acronym for Graphical Evaluation and Review Technique. The Q is appended to indicate that queuing systems can be graphically modeled. Components of Q-GERT modeling and analysis are shown in Figure 4-1.

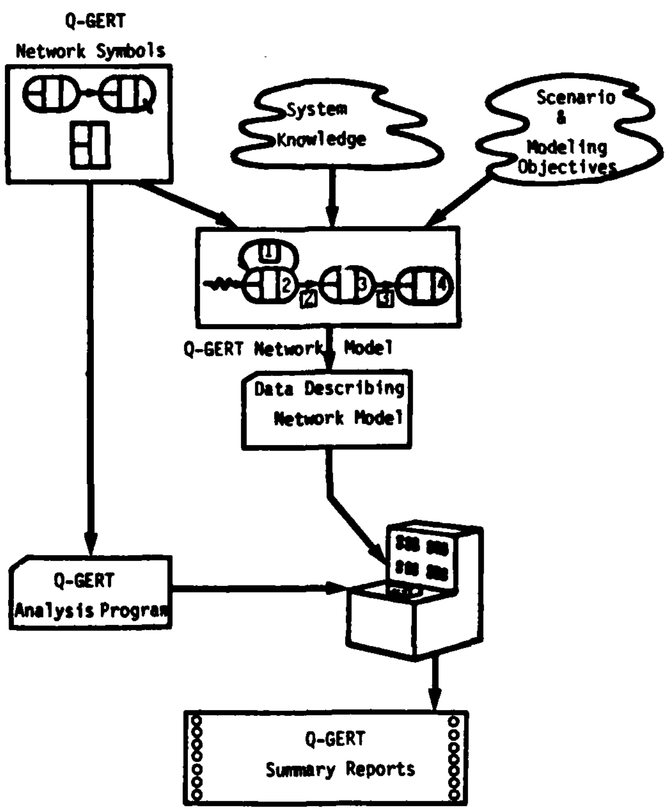

Figure 4-1. Components of Q-GERT Modeling and Analysis

b. Q-GERT Networks. The following has been taken from Modeling and Analysis Using Q-GERT Networks, Second Edition by A. Alan B. Pritsker:

"Q-GERT employs an activity-on-branch network philosophy in which a branch represents an activity that involves a processing time or a delay. Nodes are used to separate branches and are used to model milestones, decision points, and queues. A Q-GERT network consists of nodes and branches. Flowing through the network are items referred to as transactions. Transactions are directed through the network according to the branching characteristics of the nodes. Transactions can represent physical objects, information, or a combination of the two. Different types of nodes are included in Q-GERT to allow for the modeling of complex queuing situations and project management systems. Activities can be used to represent servers of a queuing system and Q-GERT networks can be developed to model sequential and parallel service systems. The nodes and branches of a Q-GERT model describe the structural aspects of the system. A process approach is taken in which the flow of a transaction is modeled. Transactions originate at source nodes and travel along the branches of the network. Each branch has a start node and an end node as shown below [see Figure 4-2]. Transactions moving across a branch are delayed in reaching the end node associated with the branch by the time to perform the activity that the branch represents. When reaching the end node, the disposition of the transaction is determined by the node type, the status of the system, and the attributes associated with the transaction. The transaction continues through the network until no further routing can be performed. Typically, this occurs at sink nodes of the network but may occur at other nodes to allow for the destruction of information flow. Transactions have attribute values that allow different types of objects (or the same type of object with different attribute values) to flow through the network. Procedures are available to assign and change attribute values of transactions at the various nodes of the network. As transactions flow through the network model, statistics are collected on travel times, the status of servers and queues, and the times at which nodes are released. Thus, a statistical data collection scheme is embedded directly in a Q-GERT network model. The Q-GERT Analysis Program employs a simulation procedure to analyze the network. The simulation procedure involves the generation of transactions, the processing of the transactions through the network, and the collection of statistics required to prepare automatically a summary report as dictated by the Q-GERT network model."

A further introductory explanation of Q-GERT and the Army Prisoner Management Model is presented at Appendix D.

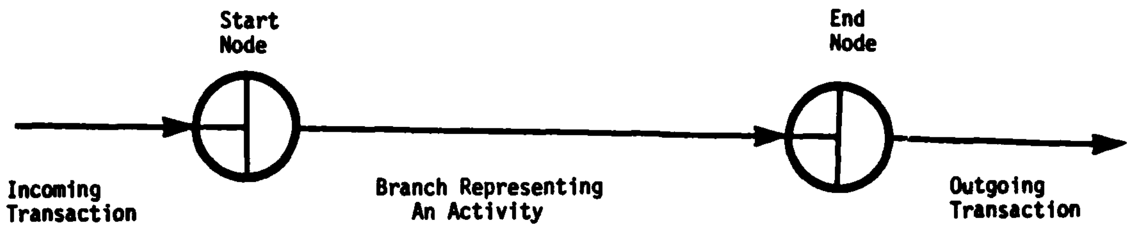

Figure 4-2. Q-GERT Process

4-4. THE ARMY PRISONER MANAGEMENT MODEL (PRISM)

a. General. The development of the procedural methodology and model for prisoner management was conducted with Q-GERT networking to be used as the ultimate model structure. The criminal justice system and analytical methodology had to be graphically represented before the system could be graphically modeled with Q-GERT.

b. Methodology Graphical Representation. The representation of the methodology for use in tracking prisoners through the criminal justice system is shown in Figure 4-3. The procedure is to generate crimes/offenses at various predetermined rates, calculate a probability that an offense type will go to a particular court-martial level, and sentence the offender. Based upon the length of the sentence to confinement, the prisoner will be sent to an installation detention facility, the US Army Correctional Activity, or the US Disciplinary Barracks. It is possible that either the USACA or USDB may be full, in which case the prisoner must remain in the IDF until there is space for him at the facility in which he will serve his confinement. Figure 4-4 represents a further disaggregation of the total prison population into subelements by sentence length. This disaggregation will allow the ACS manager to change confinement policies to preclude potential overcrowding at a particular facility. For example, if the USDB appears to be nearing an overcrowded situation and USACA will not be operating near capacity, a decision could be made to have all prisoners in the 12 to 15-month category serve their confinement at USACA rather than the USDB. This action would relieve the USDB of a population burden and simultaneously allow the USACA to operate more efficiently.

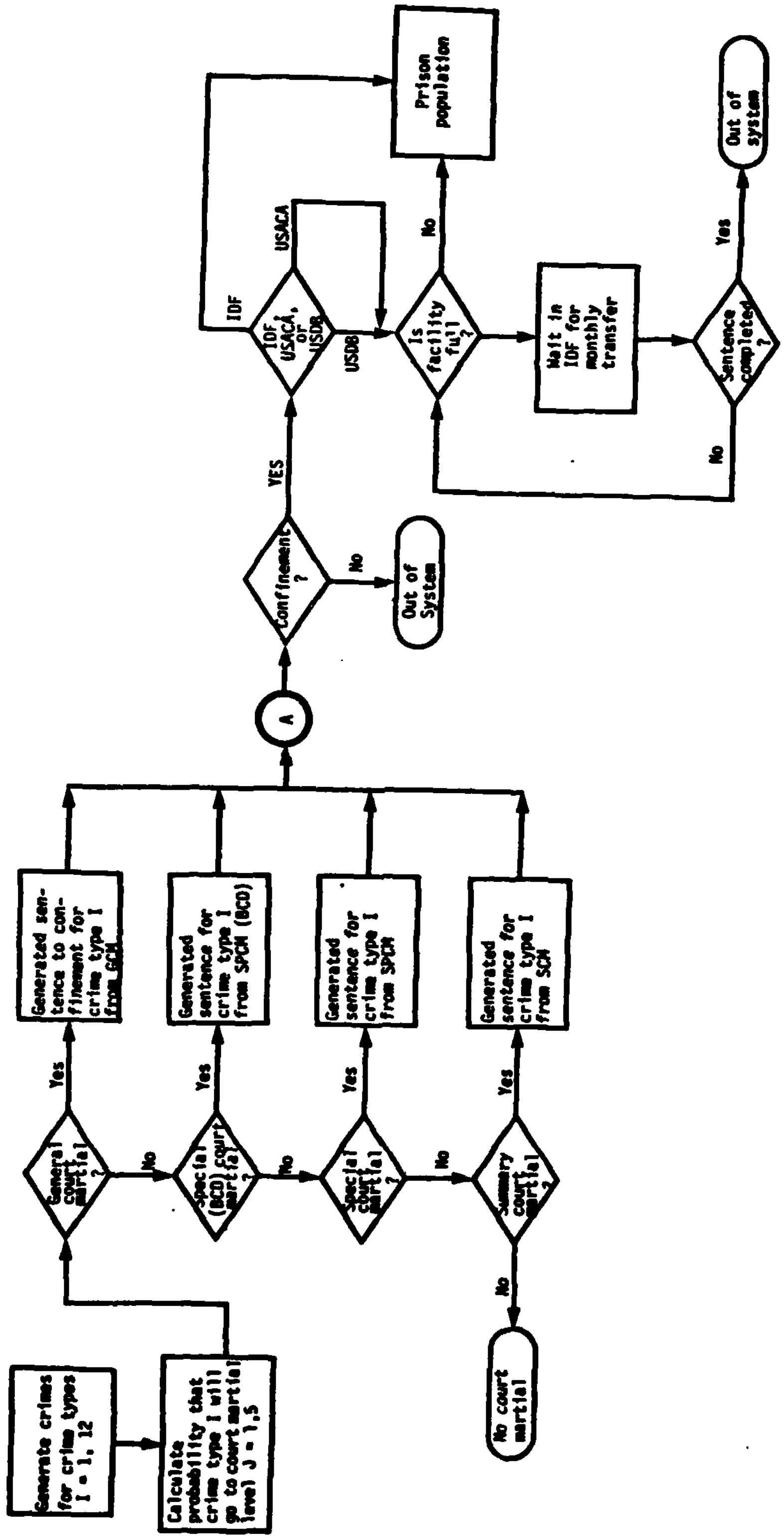

Figure 4-3. Prisoner Management Methodology

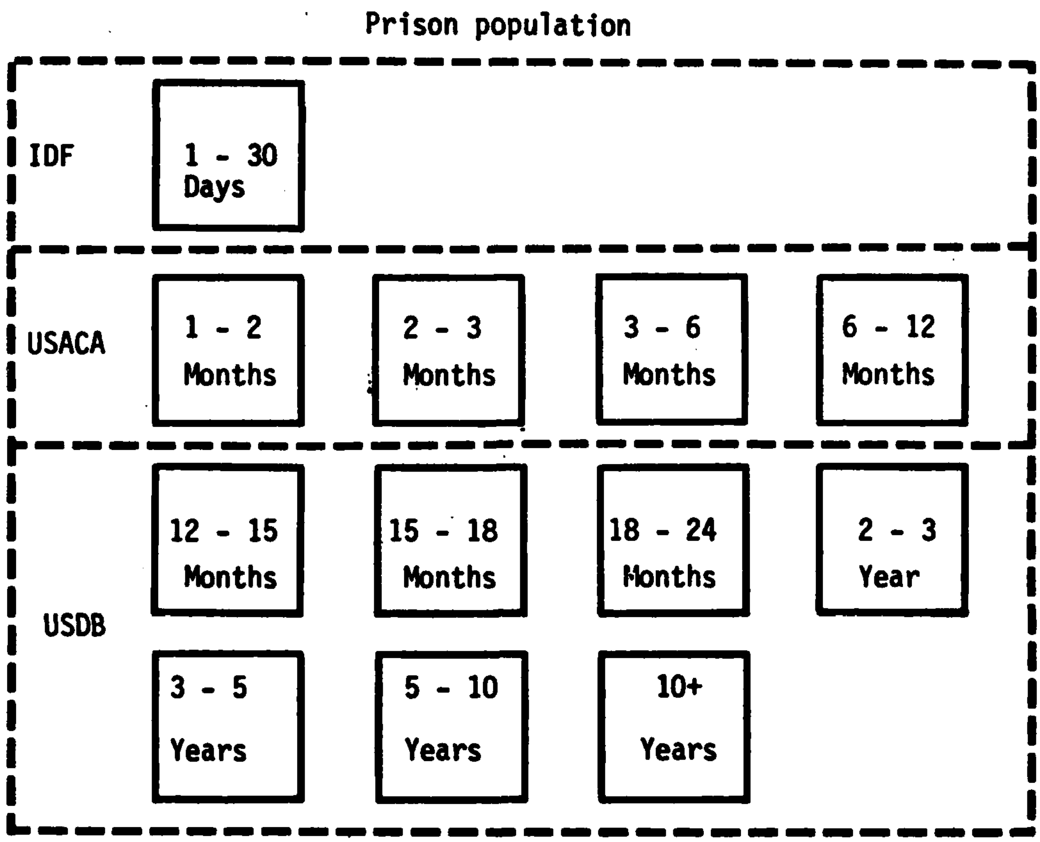

Figure 4-4. Population Allocation by Sentence Length

c. Summary. The preceding has discussed the considerations and structure of the methodology and model. A general representation of the PRISM is shown in Figure 4-5. Figure 4-6 shows the PRISM as represented using Q-GERT symbols and terminology. The explanation of this representation is fully described in Appendix D.

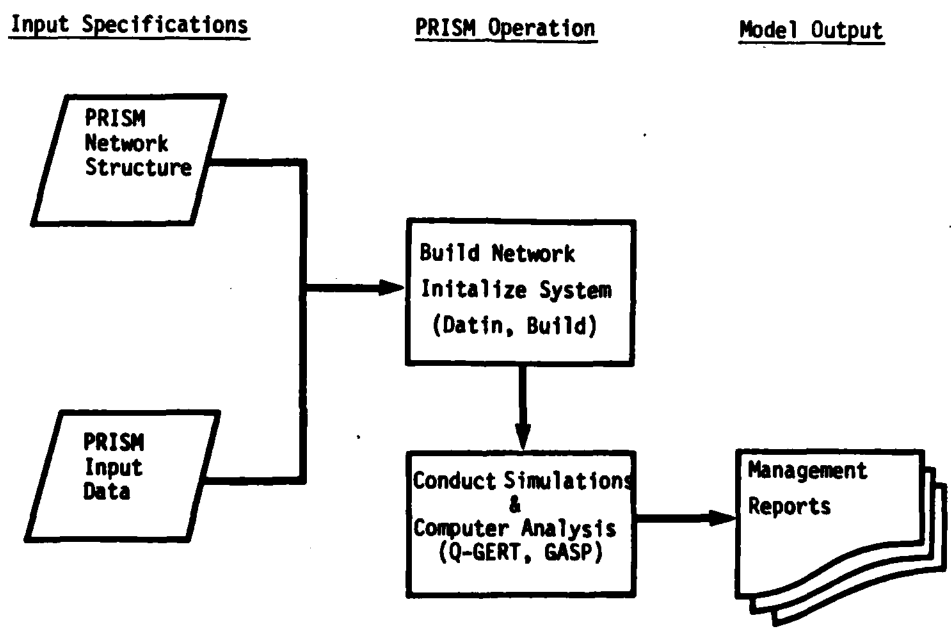

Figure 4-5. The Army Prisoner Management Model

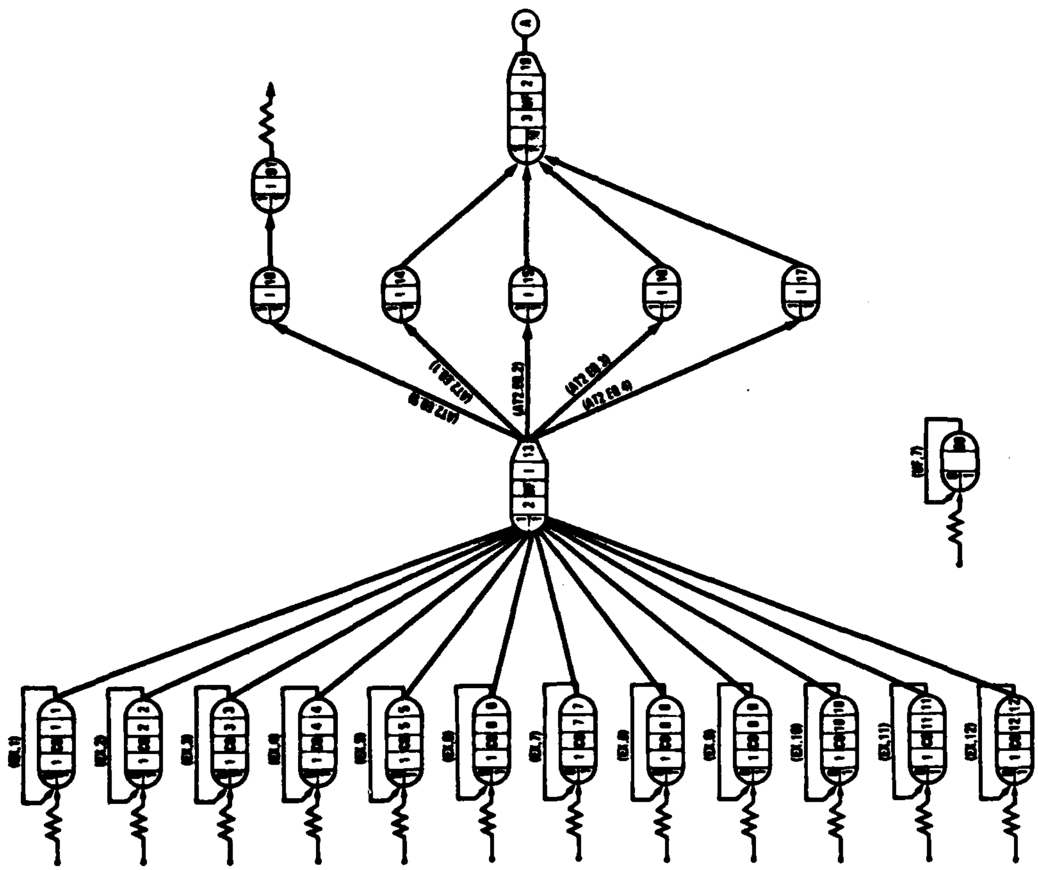

Figure 4-6. PRISM Representation with Q-GERT Structure
(page 1 of 2 pages)

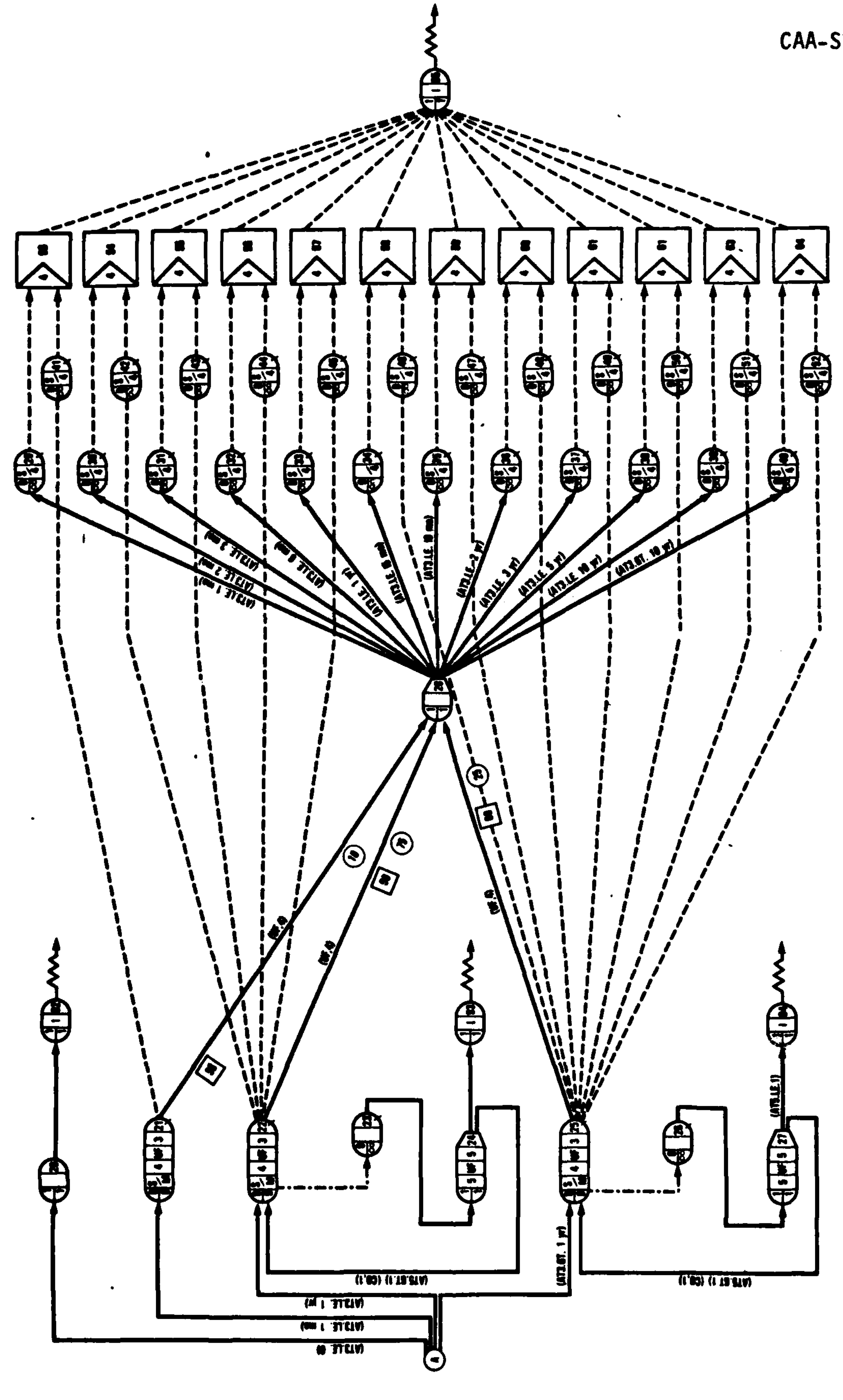

Figure 4-6. PRISM Representation with Q-GERT Structure (page 2 of 2 pages)

4-5. INPUT DEVELOPMENT

a. General. The data obtained for use in this study originated from four sources:

(1) The US Army Legal Services Agency (USALSA).

(2) The Military Police Operations Agency (MPOA).

(3) The US Army Correctional Activity (USACA).

(4) The US Disciplinary Barracks (USDB).

The data from USALSA consisted of court-martial historical information reflecting numbers of trials over time and the sentences to confinement awarded to offenders. The data from MPOA provided the study team with crime rates and prison population historical data over time. Both USACA and the USDB provided prisoner population information to be used in initializing the model and verifying the model output.

b. Data Limitations. Data limitations strongly impacted on the study effort and model development. Crime rates which are reported and collected by the Army law enforcement personnel do not include many purely military offenses. These military offenses, in some time periods, account for up to 45 percent of the short-term (6 months or less) military prisoners. An attempt to estimate the commission of these lesser offenses was made and will be described later. Further, historical data for parole/clemency board actions was not available to indicate the full impact of such actions on the prison population. The JAG files from which the court-martial data came do not maintain any information on summary courts-martial other than the number tried annually. Military offenders are, more often than not, tried for several different charges and specifications at the same trial. When a sentence is determined, it is not awarded per charge and specification, but as a sentence for all charges and specifications for which the defendant was found guilty. It was necessary to assume that the sentence to confinement was based primarily upon the most confining offense for development of sentencing criteria. These limitations hindered and, in most cases, biased the determination of crime rates, the probabilities, and probability distributions which were derived for input to the model. Heuristic and expert judgment was applied to those derivations which seemed unreasonable, and the rates or derivations were adjusted to reflect "real-life" occurrences.

c. Calculation of Crime/Offense Rates. The model has the capability to generate 12 different offense categories. The categories in the current version of PRISM are:

(1) Murder, manslaughter.

(2) Rape, carnal knowledge, kidnapping.

(3) Robbery, aggravated assault, larcency (over $50.00).

(4) Housebreaking, burglary, auto-related crimes.

(5) AWOL, desertion.

(6) Military misconduct, disrespect.

(7) Military duty avoidance, malingering.

(8) Military disturbance, assault.

(9) Neglect, abuse, or destruction of government property.

(10) Marihuana-related (use/possession) offenses.

(11) Other drug-related offenses.

(12) Other miscellaneous offenses.

The model user may change these categories or combine then in any way desired. The only requirement will be to calculate commission rates for each category. For many of these offense categories the Army law enforcement officials maintain crime rates expressed as a rate per 1,000 in the Army. However, for many of the lesser offenses, the study team had to review the court-martial data and extrapolate back to determine commission rates which would reflect the numbers of courts-martial which occurred. As this data was maintained over time, regression was applied to the extrapolated rates to observe trends in the rates and to determine the "reasonableness" of the extrapolated rates.

d. Calculation of Probabilities. Probabilities were determined for three decision points in the flow of prisoners through the model. These are:

(1) Probability that an offender committing crime type i (i = 1, 12) will go to court-martial level j (j = 1, 5; where 1 = Summary, 2 = Special, 3 = Special (BCD), 4 = General, 5 = No court-martial)

(2) Probability that an offender being tried by court-martial level j will receive no sentence to confinement.

(3) Probability that a prisoner, serving his sentence, will benefit from clemency/parole board actions.

The probabilities that offenders will be referred to court-martial varied significantly in direct relationship to the prisoner population. The manner in which these probabilities were calculated for validation purposes is explained in Chapter 5. These variables should be determined by policy actions as well as by past trends. There was little change, over time, in the other two probabilities.

e. Determination of Probability Distributions. Q-GERT is a stochastic simulation modeling technique and, as such, requires the input of probability distributions from which processing times will be drawn to schedule furture events/activities. In this model there are three activities/events for which probability distributions had to be established. These are:

(1) The generation of new offenders entering the system.

(2) The awarding of a sentence to an offender convicted of offense type i by court-martial level j.

(3) The actual time to be served by a prisoner accounting for good-time accrual.

In the first case, arrivals are generally stochastically portrayed as following a Poisson distribution. However, since the model deals with interarrival times, that is, one arrival generates (or schedules) the next arrival, the Poisson distribution is transformed into an exponential distribution. Therefore, the offense rates described above are manipulated to provide the parameters for an exponential arrival of each offender. The parameters are the mean time between arrivals, the minimum time, and the maximum time. These parameters were determined for each of the 12 offense categories described above. The second set of distributions derived were for the awarding of a sentence to confinement. For all of the offense categories, the sentences were determined to follow a conditional Gaussian distribution. Through examination of the sentences awarded by the various levels of courts-martial for each different offense, the data appeared to be relatively normally distributed. A Gaussian was, therefore, hypothesized and that hypothesis was tested. In every case the hypothesis was accepted. The distributions were then made conditional since it is unrealistic to permit the adjudging of a sentence less than zero days nor more than either the court-martial can award or the offense committed can receive. The third set of distributions pertains to how long a prisoner will actually serve after accruing good time. This set was selected based upon interviews with experts in Army corrections. The maximum amount of good-time accrual is fixed by regulation and, unless a prisoner forfeits his good time, it accrues automatically. The exponential distribution was selected as the most reasonable distribution to simulate this depletion of a sentence. The minimum time to be served is the approved sentence less the maximum good time which can be accrued. The maximum time to be served is the approved sentence. The mean time to be served is based upon the experts' opinions.

4-6. SUMMARY. This chapter has discussed the methodology/model design considerations, Q-GERT, the Army Prisoner Management Model, and the development of the model input. A further explanation of Q-GERT and PRISM is provided at Appendix D, and the model user's manual is provided at Appendix E. Collection of better data will improve the capability of the model to more accurately forecast the prisoner population workloads on the Army correctional system.

CHAPTER 5

OPERATION AND VALIDATION

5-1. INTRODUCTION. This chapter presents procedures for operation of the Army Prisoner Management Model, describes the model validation effort performed by the study team, discusses inherent limitations to the model and describes the implementation procedures for installing the model at the user's computer facility.

5-2. MODEL OPERATION

a. In keeping with the model design considerations, the Army Prisoner Management Model was designed to be relatively user friendly and easy to operate. The Q-GERT software package is a self-contained computer analysis package designed to operate on networking systems specified by the modeler. It is necessary, however, for the user's computer facility to have the Q-GERT package installed on their system. Information for obtaining this software package is included in Appendix F.

b. Given that the user has access to the Q-GERT package, all that is necessary to operate the model is the adding of the network description cards and the data input to the Q-GERT programs. The data input necessary to exercise the model are:

(1) Cumulative probabilities that a particular offense type will go to one of the court-martial levels.

(2) Probability that an offense type being tried at a particular court-martial level will receive a sentence to confinement.

(3) The parameters of the probability distributions which will award sentences to confinement for each offense, from each of the court-martial levels.

(4) The probability that a prisoner, serving a sentence to confinement will receive favorable action by the clemency/parole board.

(5) The parameters of the exponential distributions which will calculate the actual time to be served, after accounting for good-time accrual.

(6) The number that specifies the upper-bounding, sentence-length subset for confinement at an IDF. Under current confinement policies, confinement at an IDF will include only those prisoners with a sentence of 0-30 days. This subset, 0-30 days, is subset number 1 (see Figure 5-1). This input value, then, would be 1.

(7) The number that specifies the upper-bounding, sentence-length subset for confinement at USACA. Under current confinement policies, USACA will confine those prisoners with sentences to confinement of 31 days to 1 year. This input value would be 5 since the subset, 6 months to 1 year, is the fifth subset. Each of these input data elements has been prepared by the study team to reflect current rates, current probabilities, current confinement policy, etc. It is the user's responsibility to change these values as conditions in the criminal

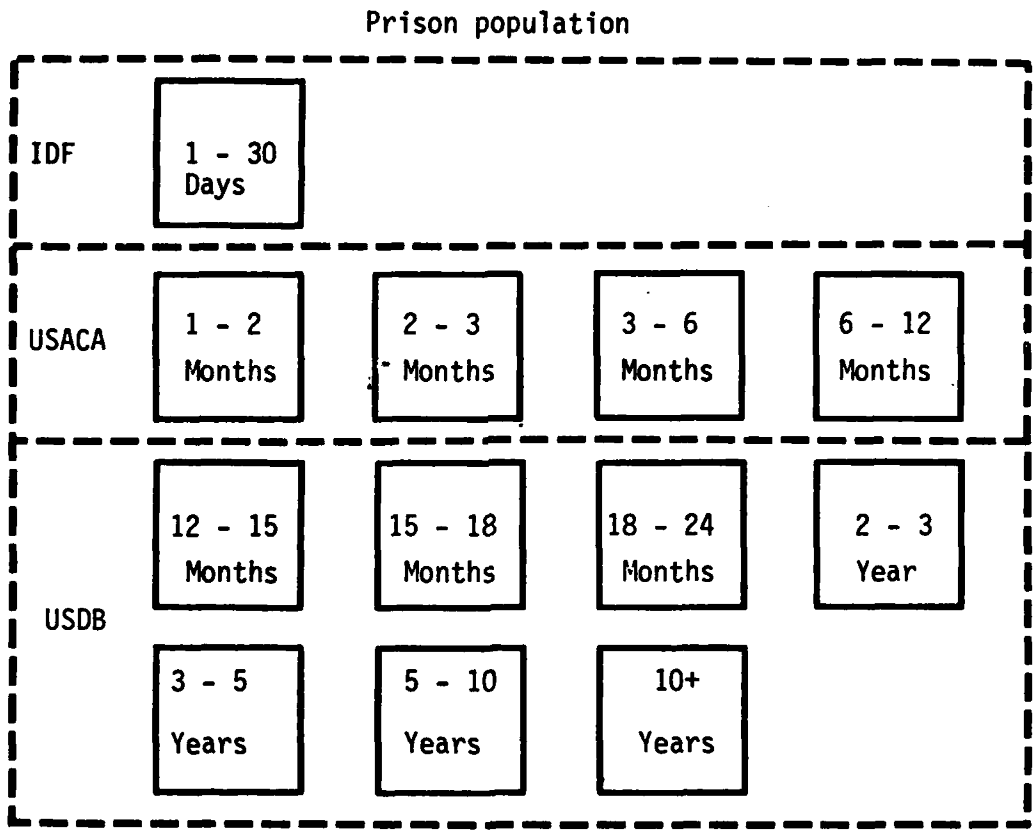

Figure 5-1. Prison Population Sentence-length Subsets

c. Output reports from the Army Prisoner Management Model consist of basically two types.

(1) The model has been designed to produce management reports specifically for the managers of the Army Correctional System. These reports are shown in Figures 5-2 and 5-3.

***** RESULTS BASED ON SIMULATION 2 *****

**** CONFINEMENT TIME SERVED BY SENTENCE LENGTH CATEGORY ****

SENTENCE CATEGORY	AVE CONF TIME (MONTHS)	STD DEV	SD OF AVE	MINIMUM	MAXIMUM	NO OF OBS
C- 1 MONTH	.4617	.2796	.0073	.0300	1.0000	1468
1- 2 MONTHS	1.3297	.3695	.0385	1.0300	2.0000	92
2- 3 MONTHS	2.1619	.2313	.0247	2.0300	3.0000	88
3- 6 MONTHS	3.5403	.6662	.0497	3.0300	6.0000	180
6-12 MONTHS	7.7255	2.1067	1.0533	6.0300	10.3737	4
12-15 MONTHS	12.5144	.0000	.0000	12.5144	12.5144	1
15-18 MONTHS	15.6815	1.0050	.3178	15.0300	17.7166	10
18-24 MONTHS	18.7394	1.0404	.2686	18.0300	21.0772	15
2- 3 YEARS	26.9498	3.8177	.8139	24.0300	34.1858	22
3- 5 YEARS	40.2063	5.8246	1.3729	36.0300	54.2258	18
5-10 YEARS	61.3479	1.5776	.9108	60.0300	63.0959	3
1C+ YEARS	NO VALUES RECORDED					

**** CONFINEMENT TIME SERVED AT SPECIFIC FACILITY ****

CONFINEMENT FACILITY	AVE CONF TIME (MONTHS)	STD DEV	SD OF AVE	MINIMUM	MAXIMUM	NO OF OBS
IDF	.4617	.2796	.0073	.0300	1.0000	1468
USACA	2.6943	1.2153	.0637	1.0300	10.3737	364
USDB	28.2764	12.1224	1.4594	12.5144	63.0959	69

Figure 5-2. Confinement Time Served by Sentence-length Category and Facility

***** AVERAGE DAILY PRISONER POPULATIONS WITHIN EACH SENTENCE LENGTH CATEGORY *****

SENTENCE CATEGORY	AVE DAILY POPULATION	STD DEV	MINIMUM	MAXIMUM	NO OF MONTHS SUMMARIZED
0- 1 MONTH	6.2971	1.9927	.0000	14.0000	72
1- 2 MONTHS	1.1511	1.0127	.0000	4.0000	72
2- 3 MONTHS	1.7831	1.1821	.0000	6.0000	72
3- 6 MONTHS	5.9302	2.4357	1.0000	13.0000	72
6-12 MONTHS	.2861	.4632	.0000	2.0000	72
12-15 MONTHS	.6379	1.8339	.0000	7.0000	72
15-18 MONTHS	1.1001	1.1698	.0000	3.0000	72
18-24 MONTHS	1.9041	.9153	.0000	4.0000	72
2- 3 YEARS	4.9976	1.6893	1.0000	8.0000	72
3- 5 YEARS	6.6441	3.0089	1.0000	11.0000	72
5-10 YEARS	5.0134	2.3854	1.0000	9.0000	72
10+ YEARS	2.2010	1.5529	1.0000	7.0000	72

***** AVERAGE DAILY PRISONER POPULATION AT SPECIFIC FACILITY *****

CONFINEMENT FACILITY	AVE DAILY POPULATION	STD DEV	MINIMUM	MAXIMUM	NO OF MONTHS SUMMARIZED
IDF	6.2971	1.9927	.0000	14.0000	72
USACA	9.1475	3.2152	1.0000	18.0000	72
USDB	21.2233	5.7111	1.0000	24.0000	72

Figure 5-3. Average Daily Prisoner Population by Sentence-length Category and Facility

(a) The confinement time served, Figure 5-2, reflects the average time that prisoners, sentenced within a particular sentence-length category or confinement facility, actually serve on their sentences. This report will reflect the impact on the ACS of increased propensity of courts to award longer sentences for the same crimes. It will also reflect the impact of policy changes in accrual of good conduct time and clemency/parole board actions.

(b) Figure 5-3 shows average daily prisoner populations computed by sentence category and by confinement/correctional facility. This report will reflect the impact upon the ACS of harsher command climate (increased tendency to send offenders to court-martial), increasing or decreasing offense rates, and the conditions mentioned above concerning average time spent in confinement.

(2) In addition to the output reports designed for the ACS managers, Q-GERT automatically produces output reports for use by the Q-GERT user. Examples of these reports are included in Appendix E.

d. The Army Prisoner Management Model is extremely easy to operate. The only requirement for the user to operate the model is the input of the PRISM network data file and the input data file. The model itself requires 100-105K of core when it is operating and completes 10 simlation runs in approximately 3 minutes. The program can be run from a terminal, in demand mode, or operated in batch mode.

e. PRISM was designed for ease of operation, speed of operation, and versatility for the ACS managers. The model achieves all of these design considerations and produces output reports which will enhance the capability of the ACS managers to plan policy decisions to effectively and efficiently control the Army Correctional System.

5-3. VALIDATION

a. The validation process of the Army Prisoner Management Model consisted simply of calculating the data for the data input file from historical data provided by the sources listed in Chapter 4 and operating the model. The output reports were then examined to evaluate the extent to which the actual prison populations (established by the data from USACA and the USDB) were duplicated by the model simulation runs. Additional runs were made to assess the behavior of the model to increased and decreased offense commission rates, referrals of offenders to courts-martial, awarding of sentence lengths, etc. Figures 5-4 through 5-7 show, respectively, the actual trends in prison populations by facility and for the total Army and courts-martial by court-martial level and total courts-martial from 1976 through 1982. As can be seen from these figures, the dramatic increase in the Army prisoner population since 1978 (which precipated this analysis) is reflected, in great measure, by a like increase in the number of referrals to court-martial. Indications are that crime rates in the Army are declining as shown in

Figure 5-8, which implies that the reasons for such an increase in courts-martial and the prisoner population are not solely related to the crime rates in the Army. The analysis performed by the study team reflects that the primary cause of fluctuations in the prisoner population is a result of a harsher view toward offenders by commanders. Although an analytical undertaking to establish such a relationship was beyond the scope of the study, interviews with personnel of the Office of The Judge Advocate General and the Military Police Operations Agency indicate that a sterner attitude towards indiscipline in the Army is being exhibited by commanders at all levels.

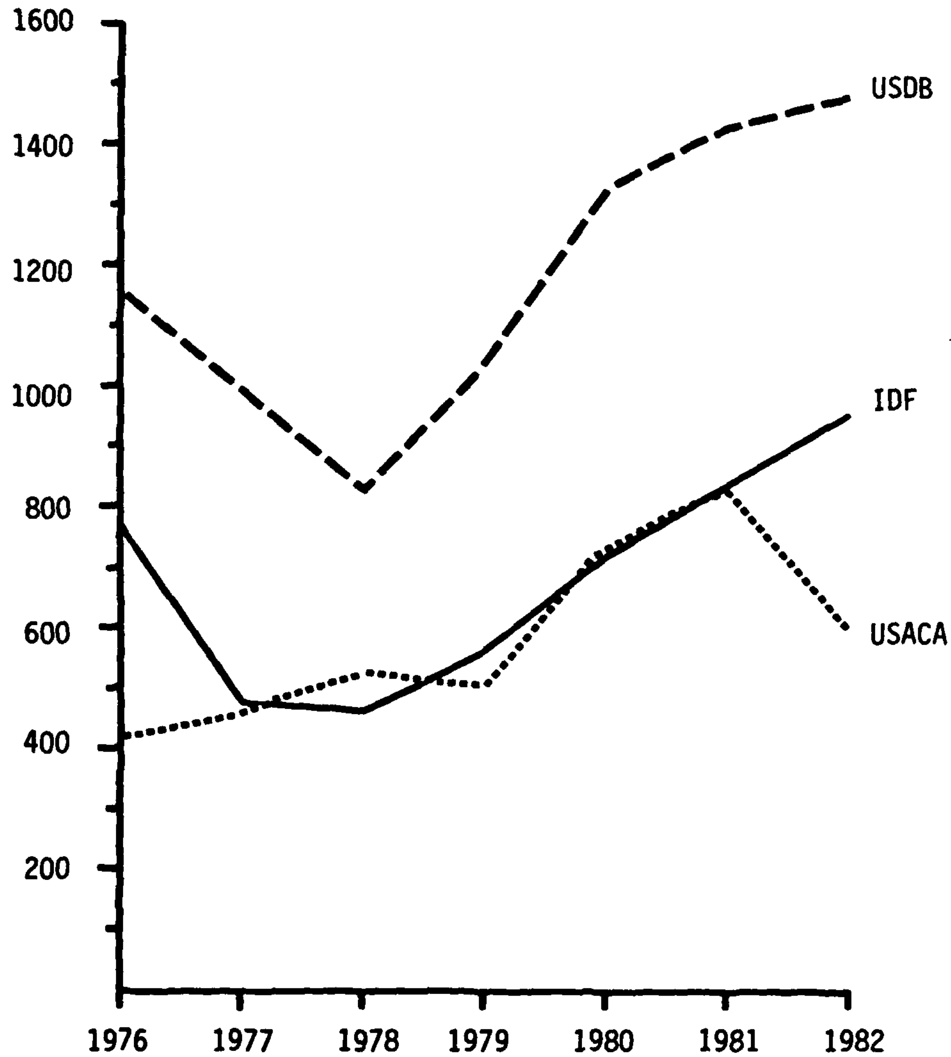

Figure 5-4. Average Daily Prisoner Population

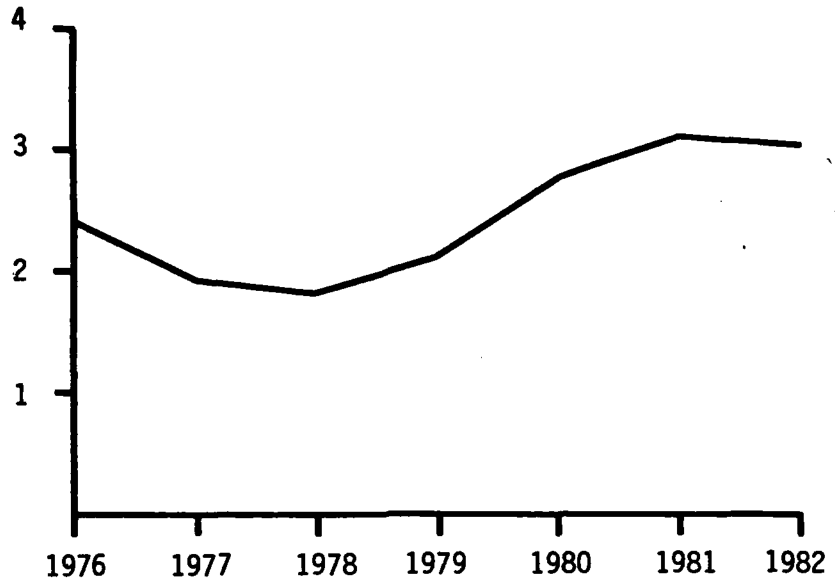

Figure 5-5. Army-wide Average Daily Prisoner Population (000)

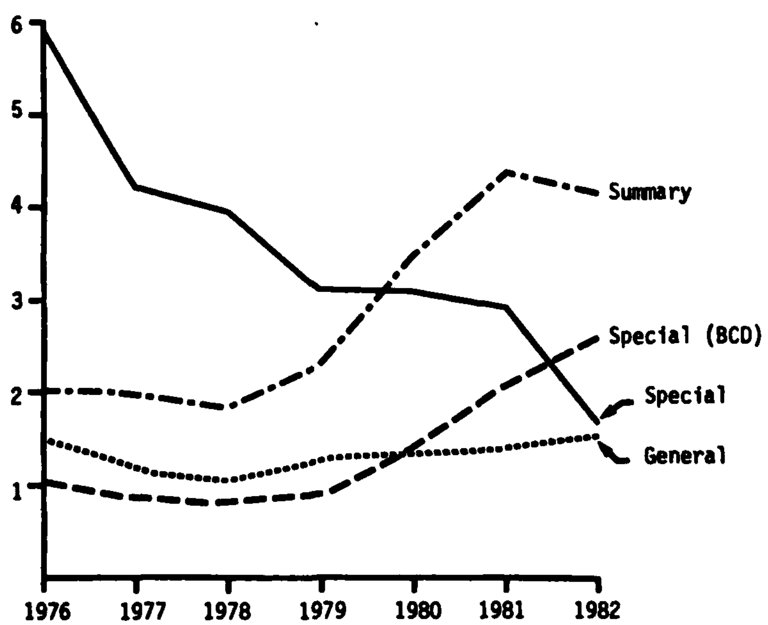

Figure 5-6. Army Courts-Martial (000)

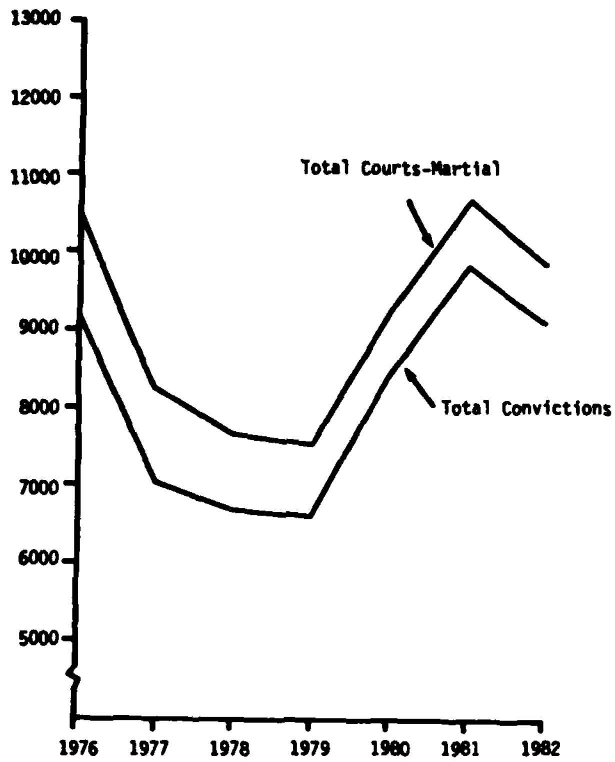

Figure 5-7. Total Army Courts-Martial (000)

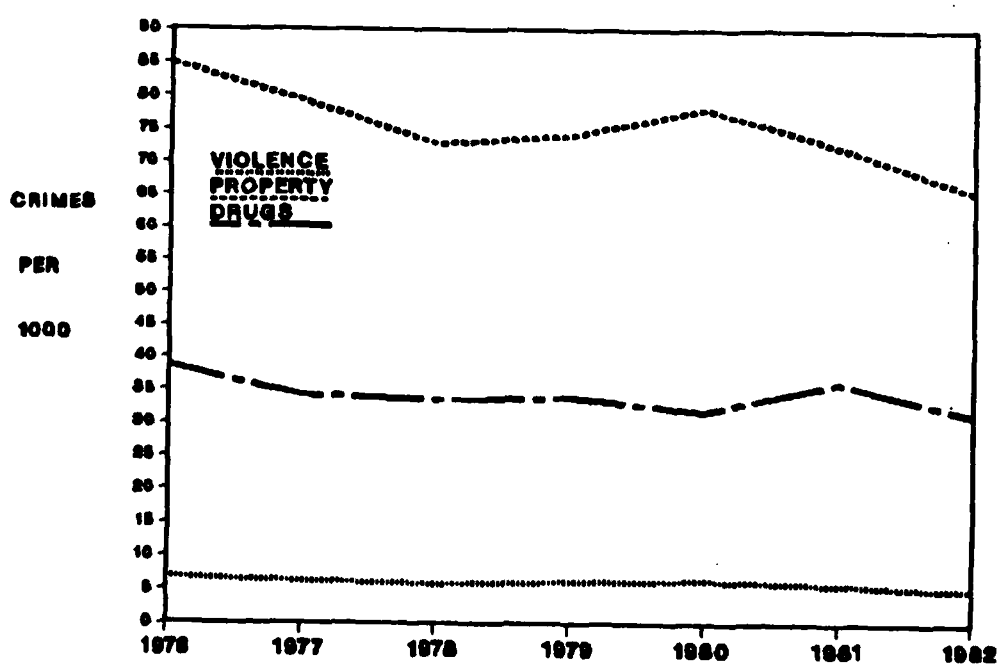

Figure 5-8. Crime Rate Trends

b. The input elements for the input data file were calaculated through a time-series, trend analysis, The model results are depicted in Figure 5-9. The model is successful in duplicating historical prison populations except for 1979 and 1980. The historical data could not indicate that a substantial increase in referrals to court-martial would occur. However, an excursion was conducted reflecting an assumed intentional, Army-wide policy to "get tough" on offenders and refer more offenders to court-martial rather than deal with them administratively. In this case, the populations for 1979 and 1980 were duplicated within 6 percent of the actual populations in those years. The Army-wide adjusted line in Figure 5-9 reflects the Army-wide average prisoner population after discounting non-Army prisoners (those of other services) in Army facilities and individuals being held in pre-trial confinement. Since PRISM cannot account for either category of prisoner, the model predictions should be compared to this adjusted population line.

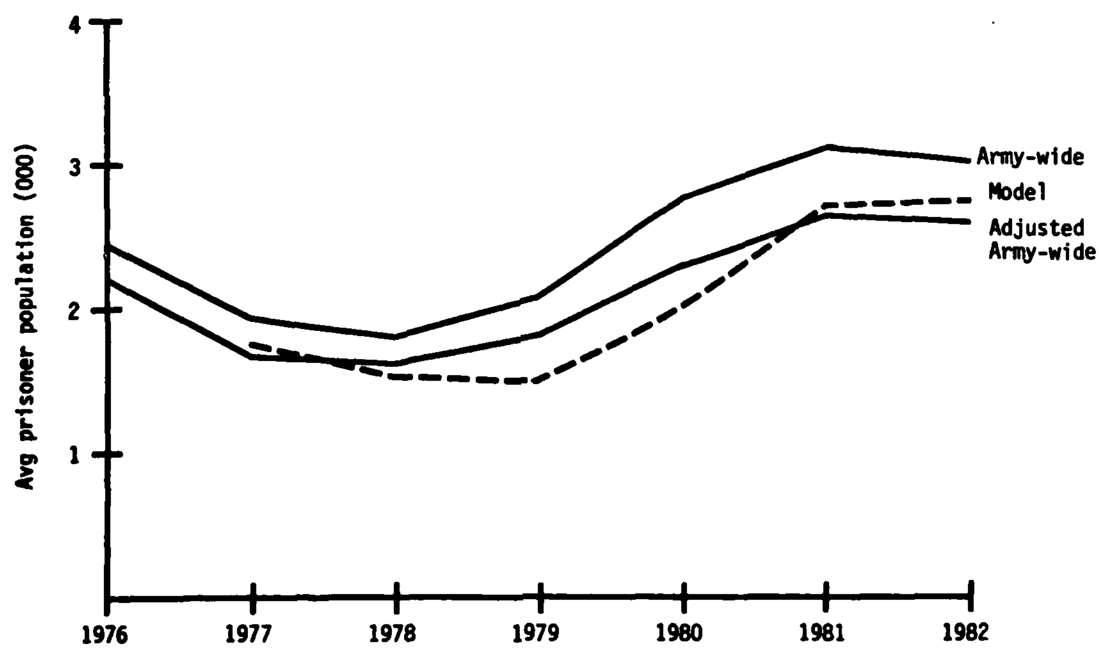

Figure 5-9. Validation Results

5-4. IMPLEMENTATION

a. The Army Prisoner Management Model, as stated in paragraph 5-2, is designed within the context of the Q-GERT software package. Any computer facility which has the Q-GERT package installed can expand the capabilities of the package and load the PRISM network data file to install the model. The programs and routines necessary to expand the capabilities of the Q-GERT package and the user subroutines necessary to operate the PRISM Model are included in Appendix F. These routines are:

(1) Procedure PROC1

(2) Program QGERT

(3) Subroutine UF

(4) Subroutine UI

(5) Subroutine UO

These subroutines and programs are explained in Appendix E, the PRISM User Manual.

b. The Q-GERT software package is a proprietary software package copyrighted by Pritsker and Associates, Inc., West Lafayette, Indiana. The package is sold/leased on a computer facility basis only. Therefore, the user must have access to the Q-GERT package in order to be able to install and operate the Army Prisoner Management Model. Information on how to obtain Q-GERT is included in Appendix F.

CHAPTER 6

SUMMARY AND OBSERVATIONS

6-1. INTRODUCTION. The purposes of this chapter are to summarize the study effort, to address the essential elements of analysis (EEA), to state the key observations of the study, and to discuss limitations of the model/methodology.

6-2. SUMMARY. The Army Prisoner Population Prediction Study resulted in the development of a methodology and model for simulating the flow of prisoners through the Army criminal justice system into the Army Correctional System. The model was designed to provide an analytical management tool to the ACS managers in order that they may better assess the effects of environmental and policy decision changes on the prison workloads. The model/methodology development is decribed in Chapter 4 while the operation and validation of the model are detailed in Chapter 5. Appendixes have been added to further assist the model users. Using input data derived from the historical records of the JAG, military police, and correctional facility files, the methodology/model was successful in duplicating historical prison populations over the time periods for which it was tested. Changes in environmental conditions, such as crime rates and probabilities that various offenses would go to court-martial, as well as confinement policy decisions were also tested. The model behaved in an appropriate manner when analyzing the effects of these changes.

6-3. ESSENTIAL ELEMENTS OF ANALYSIS (EEA). The EEA which guided the conduct of the study are stated and discussed below.

a. Does the model provide answers to various management questions, e.g., how will Army prisoners be distributed, at what levels of confinement, and how long will they be confined? The Army Prisoner Management Model (PRISM) was specifically designed to collect, analyze, and report information concerning the distribution of prisoners by sentence-length category and by facility at which confined. Information is also collected and reported for average confinement time served by sentence-length category and by facility. The allocation of the various sentence-length categories to facilities is a management decision and is input by the model user. For example, current confinement policy states that prisoners with a 1 to 30-day sentence will serve confinement in the IDF; prisoners with a 31 to 365-day sentence will serve confinement at the USACA; prisoners with a sentence of more than 365 days will serve confinement in the USDB. The various sentence-length categories may be assigned to the different levels of confinement by the model user to assess the overall prisoner distributions.

b. Does the model provide expectations for the ACS one to three years into the future? PRISM is not a predictive model. The model user must prepare and input expected future crime rates, probabilities of court-martial and, probability distributions of sentence-lengths. The model may be run as far into the future as desired but should only be projected as far into the future as the model user has faith in the input data. The major benefit to the model design is that the user may input most-optimistic and most-pessimistic rates and probabilities to obtain a range of expected prisoner population workloads. Since the model is very fast, it is quite responsive to this type of operation and does not, therefore, require extensive data preparation by the user.

c. Is the model adaptive to such changes in the system as crime rates, sentence-lengths and comfinement policies? The model was designed to have these variables input to the model by the user. Default values have been established based on the current state of the Army criminal justice system. The model user need only prepare and input those environmental or policy changes for which an assessment of the prison population workload is desired.

d. Although not an essential element of analysis, the study was to address the impact of non-Army prisoners in Army confinement/correctional facilities. The numbers of non-Army prisoners in Army facilities has been increasing over the time periods considered in this study as shown in Figure 6-1. The impact is that non-Army prisoners are increasingly occupying Army cells at a time when numbers of Army prisoners are increasing as well. Separate intensive management, and perhaps renegotiation of inter-service agreements, may become imperative should this increase continue.

Figure 6-1. Non-Army Prisoners in Army Facilities

6-4. OBSERVATIONS. The major observations resulting from the study are as follows.

a. The model, as developed, is successful in assessing the impact of environmental and policy decision changes on the prisoner population workloads.

b. The most influencing factors which cause major fluctuations in the prisoner population are, in order of greatest effect:

(1) The probability that a commander will refer an offender to court-martial rather than deal with him by non-judicial or administrative action.

(2) Crime rates.

c. The model has great versatility in accepting wide ranges of the various rates and probabilities and reporting the state of prison populations which will result. This versatility together with the ease and speed of model operation results in a practical, useful management tool.

6-5. LIMITATIONS. The major limitation in the use of the model is the data analysis and data preparation which may be required of the model user. The limitations to the data are fully explained in Chapters 4 and 5.

APPENDIX A

STUDY CONTRIBUTORS

1. STUDY TEAM

   a. <u>Study Director</u>

   CPT Robert M. Miller, Force Systems Directorate

   b. <u>Team Members</u>

   Mr. Stanley H. Miller
   Mr. Fred R. Oberman

   c. <u>Other Contributors</u>

   Mr. Bret C. Graham, Analysis Support Directorate
   Mr. Charles D. Thurston, Analysis Support Directorate

2. PRODUCT REVIEW BOARD

   LTC T. W. Hobbs, Chairman
   Dr. A. A. Khan
   Mr. H. K. Graves

3. EXTERNAL CONTRIBUTORS

   CPT R. A. Miller, USA Legal Services Agency
   Dr. E. Clayton, Virginia Polytechnic Institute and State University
   Mr. A. Pettis, USA Management Systems Support Agency

APPENDIX B

STUDY DIRECTIVE

DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY CHIEF OF STAFF FOR PERSONNEL
WASHINGTON, DC 20310

REPLY TO ATTENTION OF
DAPE-HRE

13 MAY 1983

SUBJECT: Army Prisoner Population Prediction Study (AP3)

Director
US Army Concepts Analysis Agency
8120 Woodmont Avenue
Bethesda, MD 20814

1. PURPOSE OF STUDY DIRECTIVE. This directive establishes guidance for the conduct of the Army Prisoner Population Predictions Study.

2. STUDY TITLE. Army Prisoner Population Prediction Study (AP3).

3. BACKGROUND.

a. The Human Resources Development Directorate (DAPE-HR) of the Office of the Deputy Chief of Staff for Personnel (ODCSPER) has been charged with programing and budgeting for the Army Correctional System.

b. Resource expenditures for the Army Correctional System are highly dependent upon the number of Army prisoners processed through the corrections system annually. It is, therefore, necessary to predict with relative accuracy the Army prisoner population at least over the POM years in order to accurately program required resources.

c. The method to predict prisoner population developed by US Army Correctional Activity (USACA) is sufficient and cannot be significantly improved given current data.

d. Because of an inability to accurately predict the number of prisoners in the system, personnel spaces which handle 43 percent of the prisoners have been eliminated in FY 84.

e. The Army Correctional System does not have the capability to manage daily prisoner workload in the three levels of facilities. Additionally, the ACS does not have a mechanism to model sentence length within the system.

4. STUDY SPONSOR. Deputy Chief of Staff for Personnel (DCSPER).

5. STUDY AGENCY. US Army Concepts Analysis Agency (CAA).

6. TERMS OF REFERENCE.

DAPE-HRE 13 MAY 1983
SUBJECT: Army Prisoner Population Prediction Study (AP3)

a. Problem. The Army prisoner population has increased dramatically since early 1978. Predictive capability to estimate the prisoner population in the out years is very limited at the present. No model exists to predict daily prisoner workload.

b. Purpose. Provide the Army with an analytical capability to predict the average daily prisoner population in order to program and budget resources for the Army Correctional System.

c. Objectives.

(1) Examine the Army criminal justice system and determine factors which cause changes in the Army Correctional System and provide analytical results to the study sponsor emphasizing those aspects of the system which significantly impact upon predictions of the prisoner population.

(2) Develop and provide a methodology and model to the study sponsor which will enable the Army to predict the Army average daily prisoner population over the POM years.

(3) Provide sufficient model documentation to permit operation of the model in order to assess planned policy changes on the ACS.

d. Scope.

(1) The study will focus on the Army criminal justice system with emphasis upon the Army Correctional System. It should include assessment of all levels of confinement facilities and attempt to develop a reliable, valid model to simulate the average prisoner workload for each level of confinement facility.

(2) The study should attempt to address the impact of non-Army prisoners in Army facilities on the Army Correctional System.

e. Limitations.

(1) The study will not attempt to predict non-Army prisoner populations.

(2) The study will address only enlisted male populations as officer and female prisoners represent an insignificant percentage of the prisoner population.

f. Constraints.

(1) Study results will be provided to the sponsor on or before 1 July 1983.

DAPE-HRE 13 MAY 1983
SUBJECT: Army Prisoner Population Prediction Study (AP3)

(2) Other tasks will be in accordance with the milestone schedule in paragraph 10b.

g. Assumptions.

(1) An all volunteer force will continue to exist.

(2) Confinement policies currently in force will continue to exist. The model, however, should be adaptive to policy changes.

h. Essential Elements of Analysis (EEA).

(1) Does the model provide answers to various management questions, e.g., how will Army prisoners be distributed, at what levels of confinement, and how long will they be confined?

(2) Does the model provide expectations for the ACS one to three years into the future?

(3) Is the model adaptive to such changes in the system as crime rates, sentence lengths, and confinement policies?

7. RESPONSIBILITIES.

a. ODCSPER.

(1) Will prepare an evaluation of the study results in accordance with AR 5-5.

(2) Provide a list of Points of Contact (POC) at Department of Defense (DOD); Headquarters, Department of the Army (HQDA); Major Army Commands (MACOM); and other agencies, as appropriate.

(3) Furnish available data on the Army correctional system which is under ODCSPER control/responsibility. Authorize coordination for data requirements not under ODCSPER control.

(4) If data are late or inadequate, adjust the study schedule and/or scope accordingly.

(5) Authorize and direct close and continuous coordination between CAA and Army Research Institute and US Army Operations Agency.

b. CAA.

(1) Will designate a study director and a study team.

DAPE-HRE 13 MAY 1983
SUBJECT: Army Prisoner Population Prediction Study (AP3)

(2) Will coordinate/communicate with appropriate commands/agencies for data necessary to accomplish the study.

(3) Provide periodic In-Process Reviews (IPR) as requested by ODCSPER and provide final study documentation to the study proponent.

(4) Will provide final study results to the study sponsor.

c. ARI.

(1) Will designate a POC if required.

(2) Will assist CAA study effort in data retrieval if requested.

d. MPOA.

(1) Will designate a POC if required.

(2) Will assist CAA study effort by providing background/information concerning the Army Correctional System, if requested.

8. LITERATURE SEARCH: Has been forwarded to CAA separately.

9. REFERENCES.

a. AR 5-5, The Army Study System.

b. DA Pam 5-5, Guidance for Army Study Sponsors, Sponsor's Study Directors, Study Advisory Groups, and Contracting Officer Representatives.

c. AR 340-21, The Army Privacy Program.

d. AR 10-38, United States Army Concepts Analysis Agency.

e. AR 190-47, US Army Correctional System.

10. ADMINISTRATION.

a. Support.

(1) Funds for CONUS travel/per diem will be provided by the parent organization of each study participant. ODCSPER will assist in obtaining funds and clearances for required OCONUS TDY.

(2) Clerical support will be provided by CAA.

(3) ADPE support will be provided by CAA.

DAPE-HRE 13 MAY 1983
SUBJECT: Army Prisoner Population Prediction Study (AP3)

b. Milestone schedule (additional events and a detailed schedule will be identified in the study plan). Critical events include:

(1) Brief study plan to SAG or Study Sponsor's Study Director, 20 February 1983.

(2) In-process review, 20 April 1983.

(3) Final results briefing, 15 May 1983.

(4) Delivery of study report, 30 June 1983.

c. Control procedures:

(1) ODCSPER will provide a sponsor's Study Director to provide guidance for the study.

(2) ODCSPER will prepare and submit DD Form 1498 and final study documents to DTIC.

d. Coordination. This directive has been coordinated with CAA IAW AR 10-38.

FOR THE DEPUTY CHIEF OF STAFF FOR PERSONNEL:

THOMAS A. MAC DONNELL
Colonel, GS
Chief, Office of Army
Law Enforcement

APPENDIX C

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APPENDIX D

INTRODUCTORY EXPLANATION OF Q-GERT AND PRISM

D-1. Some of the material in this appendix is extracted from Modeling and Analysis Using Q-Gert Networks (2nd ed), A. A. B. (Pritsker), John Wiley and Sons, Inc., New York, 1979. It is highly recommended that the user of the Army Prisoner Management Model (PRISM) use this book as supplementary reference material.

D-2. GENERAL. Q-GERT is an analytical tool that has been developed to provide a capability to model complex network systems and apply computer analysis to such systems. The name Q-GERT is an acronym for Queuing Systems-Graphical Evaluation and Review Technique. Q-GERT has been designed and developed to satisfy the need for a network approach to modeling systems that involve procedural, risk, and random elements. This appendix will explain the Q-GERT symbols used in the graphical development of the PRISM to allow the model user to more fully appreciate the capabilities of Q-GERT and the model.

D-3. Q-GERT TERMINOLOGY AND SYMBOLS

a. As discussed in Chapter 4, Q-GERT is an activity-on-branch network structure where a branch represents the activity. Nodes are used to separate branches and represent milestones, decision points, and queues. The items flowing through the network are referred to as transactions. The remainder of this appendix will follow the graphical representation of PRISM, discussing each symbol used in the graphical model. The full graphical model is depicted in later appearing Figure D-9.

b. The first sequence of events/activities in PRISM, shown in Figure D-1, represents the generation of 12 different offenses. The specific offenses or aggregation of offenses into offense categories to be modeled is determined by the user. Each of these nodes in the first stage is a source node designated by the special symbol (arrow) on the left of the node. In this example, node 7 is designated as a source node which requires no arriving transactions to release it initially and the node will be released each time a transaction arrives. Releasing of a node merely implies that all actions which are to occur at a node will occur when the node is released. For each transaction, attribute number 1 (the attributes are characteristics of each transaction carried in a vector associated with that transaction) is set to a constant 7 at this node. The releasing of this node causes the following actions to occur:

(1) Attribute 1 is set with the offense type.

(2) The arrival of the next offense is determined by an exponential function with parameters established by parameter set 7.

(3) The transaction being released begins activity number 19 which will require a constant 0.0 amount of time to complete.

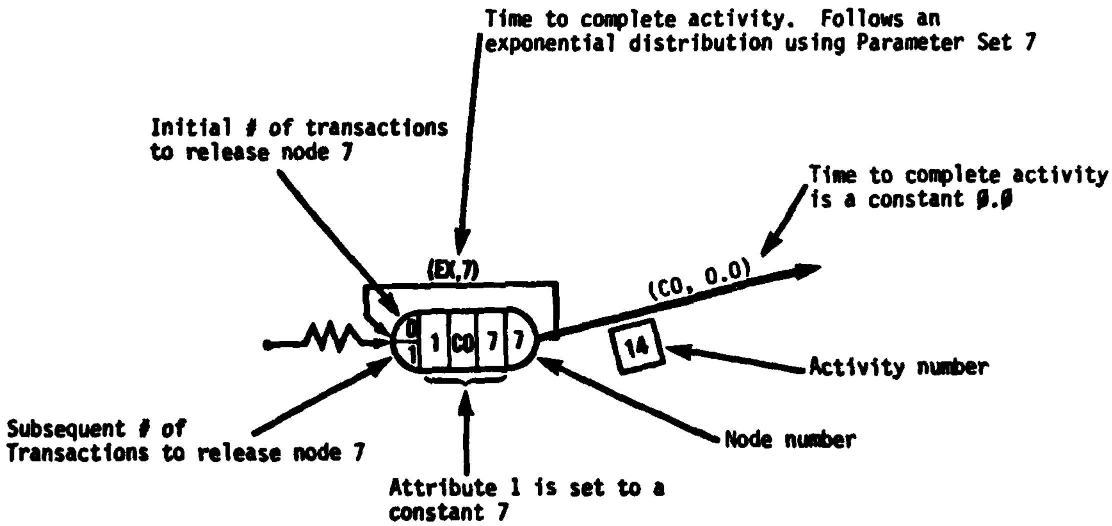

Figure D-1. Generation/Arrival of Offenses

c. The second stage in the graphical model, shown in Figure D-2 represents the decision point to determine the level of court-martial at which the committed offense will be tried. The decision is made probabilistically within the subroutine, UF (User Function). The shape of the right side of this node represents a conditional-take-first branching rule; that is the first branch whose conditions are satisfied will be followed and no further branches will be examined. The releasing of this node causes two actions to occur:

(1) Attribute 2 is set with the level of court martial.

(2) The transaction being released will follow the branch whose conditions are first satisfied.

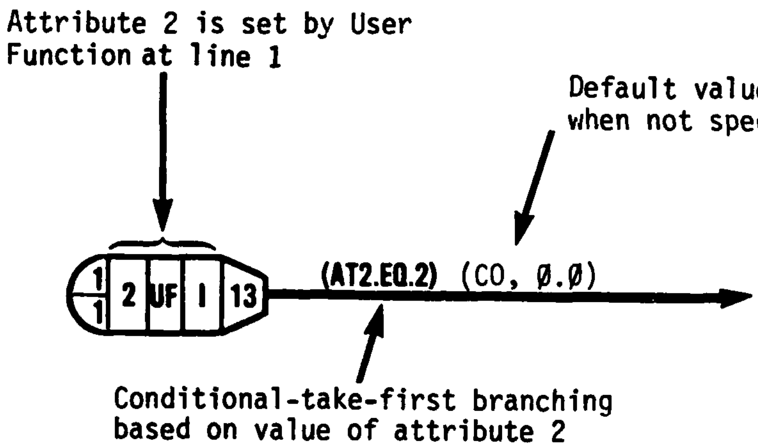

Figure D-2. Determination of Court-martial Level

d. The third stage, shown in Figure D-3, represents the five levels of court-martial at which an offense may be tried, General Court-Martial, Special Court-Martial empowered to award a Bad Conduct Discharge, Special Court-Martial, Summary Court-Martial or no Court-Martial. The only new terminology represented by this node is that collection of interval statistics is designated to be made.

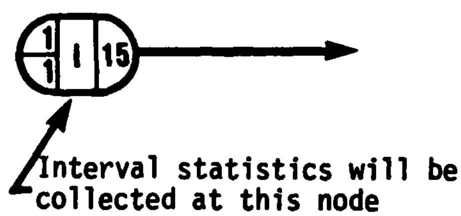

Figure D-3. Representation of Court-martial Level

e. The fourth stage of PRISM consists of two different types of nodes. A sink node, Figure D-4, into which those transactions not going to court-martial will be processed and a regular node at which conditional-take-first branching will occur, Figure D-5. At node 19 the user function will be used to award a sentence to the transaction being currently processed based on attribute 1, the offense type, and attribute 2, the level of court-martial at which the offense was tried. The length of the sentence to confinement is assigned as attribute 3 and conditional branching occurs depending on the value of attribute 3.

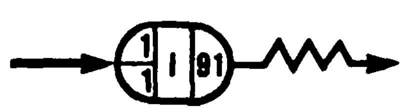

Figure D-4. Sink Node for No Court-martial Processing

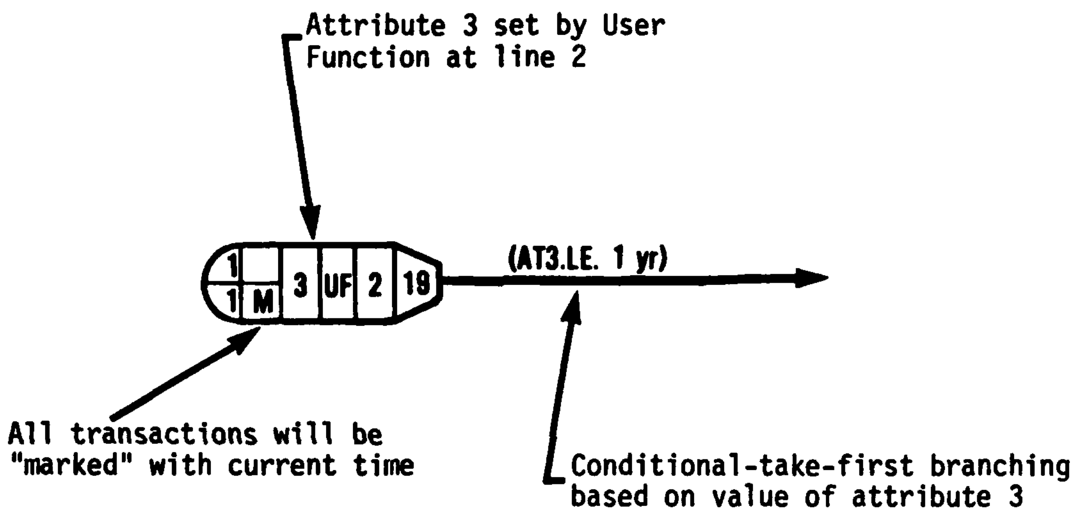

Figure D-5. Awarding of a Sentence

f. The fifth stage of the graphical representation of PRISM is the most complicated, perceptually, of the model. Represented are the confinement/correctional facilities (nodes 21, 22 and 25) and the procedure for handling prisoners (transactions) being sent to either the USACA or the USDB. Node 20 is merely the regular node at which statistics are collected for those transactions being tried but receiving no sentence to confinement. Figure D-6 shows that portion of the model pertaining to the processing of a transaction into the USDB.

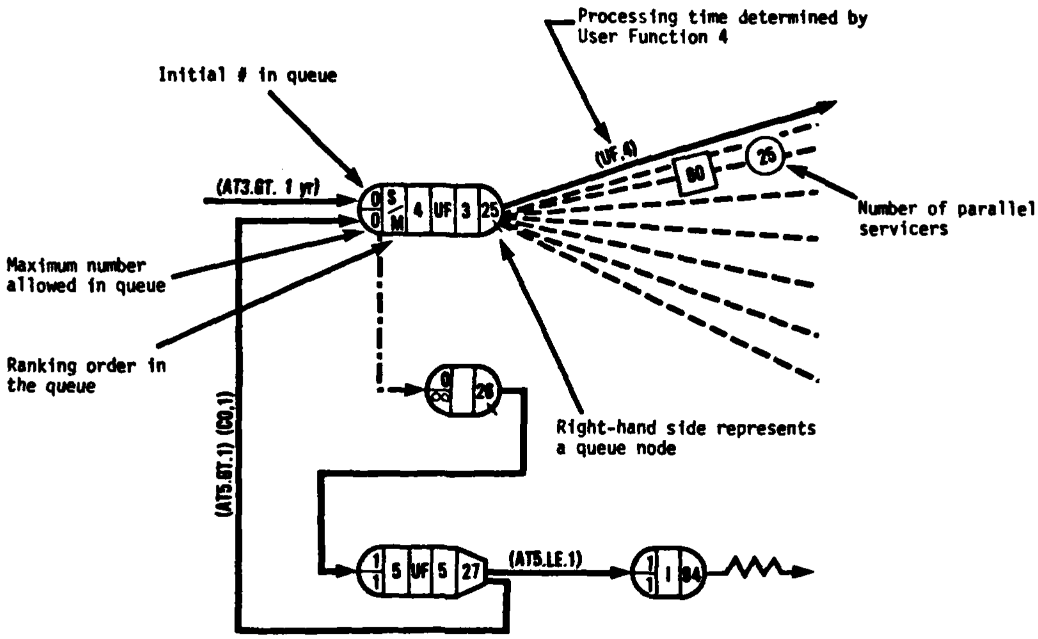

Figure D-6. Transaction Processing at a Correctional Facility

Queue node 25 represents the USDB. In this case the branch following node 25 shows 25 parallel servers, each of which can process one transaction at a time. These servers may be viewed as prison cells. The model does not permit any prisoners to wait within node 25 for a server to become available, if all servers are busy when the transaction arrives. Instead, the transaction will "balk" (dash-dot line) to Q-node 26 which will process the transaction with zero time to node 27. At node 27, User Function 5 will calculate the time remaining on the sentence, award that remaining time as attribute 5, and will either send the transaction to sink node 94, if the sentence to confinement has been served, or route the transaction back to Q-node 25 to see if the remaining sentence can be served at the USDB. At Q-node 25, the queue ranking order is based upon the smallest "mark time." Since each transaction was marked at node 19, the smallest mark time is the transaction which has been in the system the longest. As each transaction is processed by node 25, User Function 3 is employed to give each transaction a unique identification number and then award that number as attribute 4. Simultaneously, as will be explained later, a mirror-image of each transaction is created for use further on in the model. As each transaction leaves node 25, the time to complete the next activity (serve confinement time) is computed by User Function 4. The dashed lines emanating from the right hand side of these nodes represent direct routing of a transaction and do not involve any associated activity or processing time.

g. The sixth stage of the model is identical to the fourth stage. It consists of a sink node (node 92) and a regular node with conditional-take-first branching. The sink node is for those transactions which did not receive a sentence to confinement. The regular node is a decision point to route transactions to the proper queue node corresponding to the length of the sentence each transaction was to serve, i.e., 61-90 days, 12-15 months, etc.

h. The seventh stage, depicted in Figure D-8, is a combination of two queue nodes paired with a match node. The match node, Figure D-7, is utilized in this model to pair up the transaction which has just completed serving a confinement sentence with its image transaction sent by node 21, 22, or 25. This process of imaging and matching allows the collection of statistics on the transactions which are being processed by activities 58, 59, and 60. Since statistics can only be collected at nodes, information about how many and for how long transactions were actually in confinement would otherwise be lost.

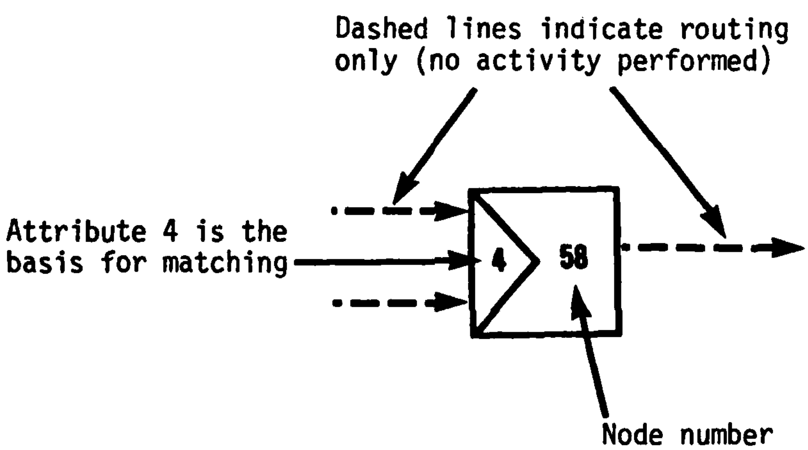

Figure D-7. Match Node

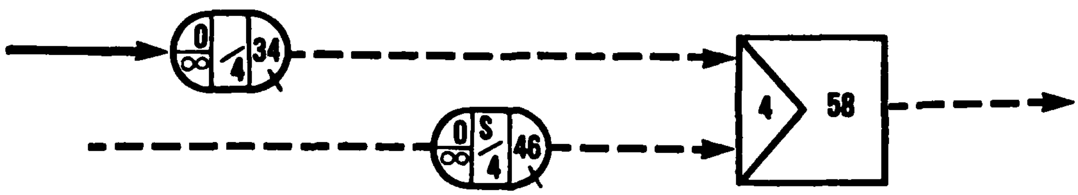

Figure D-8. Matching of Transactions

As Figure D-8 shows, the transaction which began serving confinement during activity 60 had its image placed in Q-node 46. When the sentence has been served, the original transaction arrives at node 34 and match node 58 will pair the transactions for further processing. In this manner, all statistics which pertain to the transactions engaged in activity 60 (serving confinement) can be obtained by observing the transaction(s) in queue node 46.

i. The last stage of the graphical representation is simply the sink node, node 95, into which all transactions which have completed serving confinement are gathered.

j. Figure D-9, the Army Prisoner Management Model in Q-GERT graphical form, shows a source node (node 80) below the second stage of the model. This node represents the generation of a timing transaction. Every time an arrival causes the node to be released (the first release occurs at time zero since it is a source node) the next arrival will be generated according to user function 7. This portion of the user functions was written to allow the collection of special information for later output. By using a timing transaction, such information collection can be done regularly at specific times, in this case every month.

k. This completes the graphical description of the model, PRISM. The remainder of the appendix will discuss the input of the network for computer analysis by the Q-GERT Analysis Program.

D-4. Q-GERT MODEL INPUT

a. To prepare the model, as represented by the Q-GERT graphical network for computer analysis, it is necessary only to create a set of input records containing the network data. In general, a record is necessary to represent each node, activity, parameter set for each stochastic function used, and each assignment of an attribute. In addition a header card with general information and a trailer card to indicate the end of the network are necessary.

b. The Q-GERT Analysis Program automatically obtains and provides data and statistical estimates resulting from the network, such as:

(1) Average time a transaction spends in the system.

(2) Average number of transactions in the Q-nodes.

(3) Average fraction of time a server is busy/idle.

Many other types of output are generated automatically. It is sufficient to say that translation of a network model to input data is direct and that generation of output statistics is automatic. The PRISM model also has output reports that have been developed specifically to satisfy the needs of the Army Correctional System managers.

c. Annex I to this appendix is a listing of the PRISM Q-GERT input records. The input requirements for each type of record are provided in Annex II.

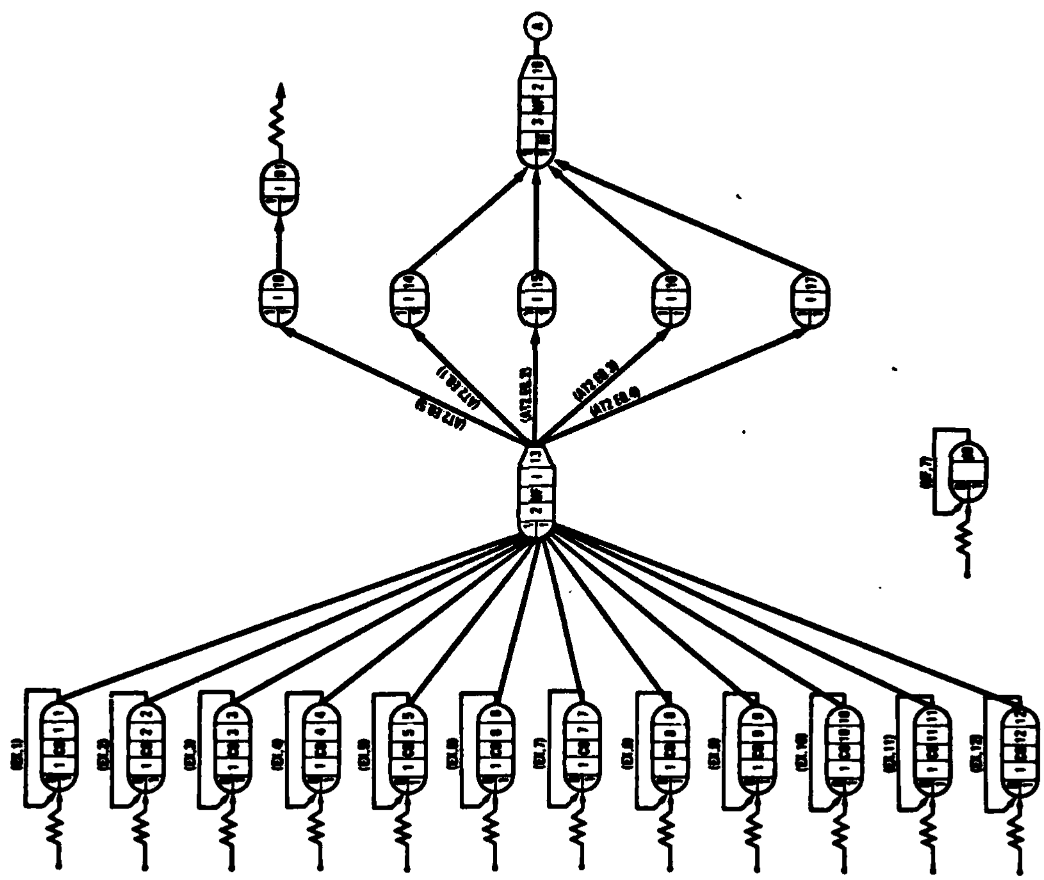

Figure D-9. The Army Prisoner Management Model
(page 1 of 2 pages)

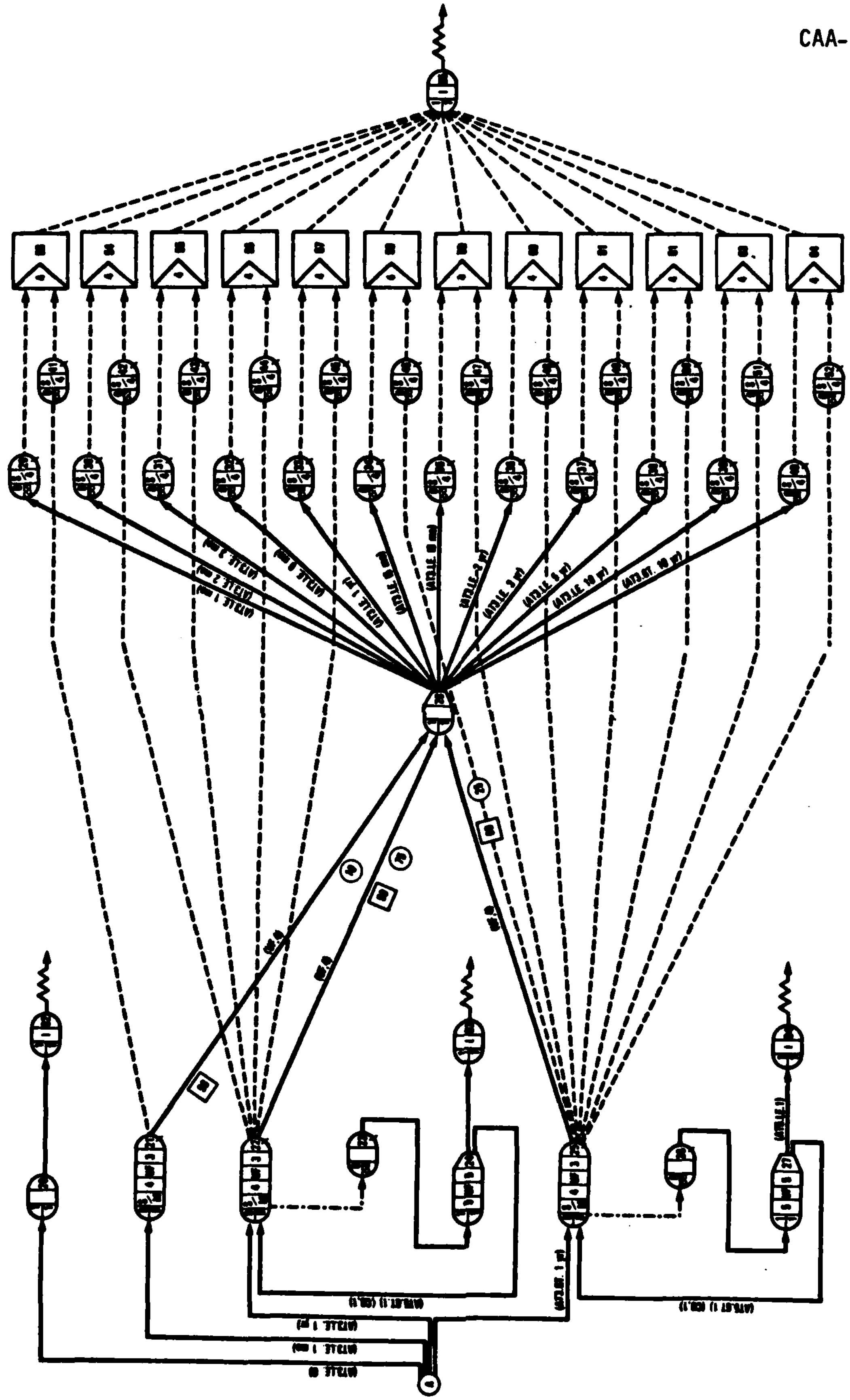

Figure D-9. The Army Prisoner Management Level
(page 2 of 2 pages)

ANNEX I TO APPENDIX D

PRISM NETWORK INPUT RECORDS

```
GEN,MILLER,PRISON STUDY,(8)5,9999,108,10,C,37,5,*
SOU,1,0,1,D*                                                  TYPE 1
SOU,2,0,1,D*                                                  TYPE 2
SOU,3,0,1,D*                                                  TYPE 3
SOU,4,0,1,D*                                                  TYPE 4
SOU,5,0,1,D*                    C R I M E                     TYPE 5
SOU,6,0,1,D*                  S O U R C E S                   TYPE 6
SOU,7,0,1,D*                                                  TYPE 7
SOU,8,0,1,D*                                                  TYPE 8
SOU,9,0,1,D*                                                  TYPE 9
SOU,10,0,1,D*                                                 TYPE 10
SOU,11,0,1,D*                                                 TYPE 11
SOU,12,0,1,D*                                                 TYPE 12
SOU,80,0,1,D*                                 TIMING NODE
REG,13,1,1,F*                COURT MARTIAL CHOICE NODE  (ATTRIBUTE 2)
REG,14,1,1,D*                                 SUMMARY COURT MARTIAL
REG,15,1,1,D*                                 SPECIAL COURT MARTIAL
REG,16,1,1,D*                                 SPECIAL(BCD) COURT MARTIAL
REG,17,1,1,D*                                 GENERAL COURT MARTIAL
REG,18,1,1,D*                                 NO COURT MARTIAL
REG,19/AWD-SENT,1,1,F,M*       AWARD SENTENCE BY CRIME TYPE (ATTRIBUTE 3)
REG,20/NO  CONF,1,1,D*
REG,24/BALK-ACA,1,1,F*
REG,27/BALK-DB ,1,1,F*
REG,28/CONFINE ,1,1,F*
QUE,21/IDFAC,0,,D,S/M*
QUE,22/USACA,0,0,D,S/M,23*
QUE,23/USACA,0,,D,S/M*
QUE,25/USADB,0,0,D,S/M,26*
QUE,26/USADB,0,,D,S/M*
QUE,29,0,,D,S/4,(10)53*
QUE,30,0,,D,S/4,(10)54*
QUE,31,0,,D,S/4,(10)55*
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QUE,42,0,,D,S/4,(10)54*
QUE,43,0,,D,S/4,(10)55*
QUE,44,0,,D,S/4,(10)56*                   S E N T E N C E
QUE,45,0,,D,S/4,(10)57*                      L E N G T H
QUE,46,0,,D,S/4,(10)58*                C A T E G O R I E S
QUE,47,0,,D,S/4,(10)59*
QUE,48,0,,D,S/4,(10)60*
QUE,49,0,,D,S/4,(10)61*
QUE,50,0,,D,S/4,(10)62*
QUE,51,0,,D,S/4,(10)63*
QUE,52,0,,D,S/4,(10)64*
MAT,53,4,29/95,41*
MAT,54,4,30/95,42*
MAT,55,4,31/95,43*
MAT,56,4,32/95,44*
MAT,57,4,33/95,45*
MAT,58,4,34/95,46*
MAT,59,4,35/95,47*
MAT,60,4,36/95,48*
MAT,61,4,37/95,49*
MAT,62,4,38/95,50*
MAT,63,4,39/95,51*
MAT,64,4,40/95,52*
SIN,91/NONE-CM,1,1,D,I*      NO-CM AND NO CONFINEMENT, LEAVE SYSTEM
SIN,92/CM-NOCON,1,1,D,I*       CM  BUT NO CONFINEMENT, LEAVE SYSTEM
SIN,93/BALK ACA,1,1,D,I*          BALK FROM USACA, LEAVE SYSTEM
SIN,94/ BALK DB ,1,1,D,I*           BALK FROM USADB, LEAVE SYSTEM
SIN,95/END CONF,1,1,D,I*              COMPLETE CONFINEMENT, LEAVE SYSTEM
VAS,1,1,CO,1,C*
VAS,2,1,CO,2,C*
VAS,3,1,CO,3,C*
VAS,4,1,CO,4,C*                          A S S I G N M E N T
VAS,5,1,CO,5,C*                                   O F
VAS,6,1,CO,6,C*                        O F F E N S E  T Y P E
VAS,7,1,CO,7,C*                                   T O
VAS,8,1,CO,8,C*                         A T T R I B U T E  # 1
VAS,9,1,CO,9,C*
VAS,10,1,CO,10,C*
```

```
VAS,11,1,CO,11.0*
VAS,12,1,CO,12.0*
VAS,13,2,UF,1*
VAS,19,3,UF,2*
VAS,21,4,UF,3*
VAS,22,4,UF,3*
VAS,25,4,UF,3*
VAS,24,5,UF,5*
VAS,27,5,UF,5*
VAS,41,5,UF,6*
VAS,42,5,UF,6*
VAS,43,5,UF,6*
VAS,44,5,UF,6*
VAS,45,5,UF,6*
VAS,46,5,UF,6*
VAS,47,5,UF,6*
VAS,48,5,UF,6*
VAS,49,5,UF,6*
VAS,50,5,UF,6*
VAS,51,5,UF,6*
VAS,52,5,UF,6*
ACT,1,1,EX,1,1*
ACT,2,2,EX,2,2*
ACT,3,3,EX,3,3*
ACT,4,4,EX,4,4*
ACT,5,5,EX,5,5*
ACT,6,6,EX,6,6*
ACT,7,7,EX,7,7*
ACT,8,8,EX,8,8*
ACT,9,9,EX,9,9*
ACT,10,10,EX,10,10*
ACT,11,11,EX,11,11*
ACT,12,12,EX,12,12*
ACT,80,80,UF,7*
PAR,1,8.767,00.00,9.644*
PAR,2,0.677,00.00,0.744*
PAR,3,3.152,00.00,3.467*
PAR,4,2.587,00.00,2.847*
PAR,5,0.468,00.00,0.515*
PAR,6,0.568,00.00,0.625*
PAR,7,4.500,00.00,4.950*
PAR,8,1.919,00.00,2.110*
PAR,9,5.031,00.00,5.534*
PAR,10,0.723,00.00,0.795*
PAR,11,2.213,00.00,2.434*
PAR,12,.1040,00.00,.1140*
PAR,51,0.7333,0.0,1.0,0.2*
PAR,52,0.7333,0.0,1.0,0.2*
PAR,53,0.7333,0.0,1.0,0.2*
PAR,54,0.7333,0.0,1.0,0.2*
PAR,55,0.7333,0.0,1.0,0.2*
PAR,56,0.7333,0.0,1.0,0.2*
PAR,57,0.7333,0.0,1.0,0.2*
PAR,58,0.7333,0.0,1.0,0.2*
PAR,59,0.7333,0.0,1.0,0.2*
PAR,60,0.7333,0.0,1.0,0.2*
PAR,61,0.7333,0.0,1.0,0.2*
PAR,62,0.7333,0.0,1.0,0.2*
PAR,63,06.000,6.0,6.0,0.0*
PAR,64,06.000,1.0,6.0,0.6*
PAR,65,05.000,1.0,6.0,0.5*
PAR,66,03.000,1.0,6.0,0.3*
PAR,67,04.000,1.0,6.0,0.4*
PAR,68,02.000,1.0,6.0,0.2*
PAR,69,02.000,1.0,6.0,0.2*
PAR,70,03.000,1.0,6.0,0.3*
PAR,71,03.000,1.0,6.0,0.3*
PAR,72,02.000,1.0,6.0,0.2*
PAR,73,04.000,1.0,6.0,0.4*
PAR,74,01.000,1.0,1.0,0.0*
PAR,75,06.000,6.0,6.0,0.0*
PAR,76,06.000,1.0,6.0,0.6*
PAR,77,05.000,1.0,6.0,0.5*
PAR,78,04.000,1.0,6.0,0.4*
PAR,79,06.000,1.0,6.0,0.6*
PAR,80,03.000,1.0,6.0,0.3*
PAR,81,03.000,1.0,6.0,0.3*
PAR,82,04.000,1.0,6.0,0.4*
PAR,83,03.000,1.0,6.0,0.3*
PAR,84,04.000,1.0,6.0,0.4*
PAR,85,06.000,1.0,6.0,0.6*
PAR,86,01.000,1.0,1.0,0.0*
```

ATTRIBUTE #2 = LEVEL OF COURT MARTIAL
ATTRIBUTE #3 = APPROVED SENTENCE LENGTH
ATTRIBUTE #4 = TRANSACTION ID NUMBER

INTERARRIVAL
OF
OFFENSES
(ACTIVITIES 1 - 12)

TIMING TRANSACTION GENERATION (UF=7)

PARAMETERS
TO DEFINE
INTER-ARRIVAL
TIMES
(PARAMETERS 1 - 12)

PARAMETERS TO DEFINE
DISTRIBUTIONS WHICH CALCULATE
APPROVED SENTENCE LENGTHS
FOR SUMMARY COURT MARTIALS
(PARAMETERS 51-62)

PARAMETERS TO DEFINE
DISTRIBUTIONS WHICH CALCULATE
APPROVED SENTENCE LENGTHS
FOR SPECIAL COURT MARTIALS
(PARAMETERS 63-74)

PARAMETERS TO DEFINE
DISTRIBUTIONS WHICH CALCULATE
APPROVED SENTERNCE LENGTHS
FOR SPECIAL(BCD) COURT MARTIALS
(PARAMETERS 75-86)

```
PAR,87,108.000,12.,240.,36.*           --------                 --------
PAR,88,084.000.09.,240.,15.*           I                                I
PAR,89,54.0000,06.,240.,10.*           I                                I
PAR,90,22.0000,04.,240.,06.*           I      PARAMETERS TO DEFINE      I
PAR,91,24.0000,05.,240.,06.*           I DISTRIBUTIONS WHICH CALCULATE  I
PAR,92,18.0000,04.,240.,04.*           I   APPROVED SENTENCE LENGTHS    I
PAR,93,14.0000,03.,240.,06.*           I   FOR GENERAL COURT MARTIALS   I
PAR,94,26.0000,05.,240.,08.*           I      (PARAMETERS  87-98)       I
PAR,95,20.0000,04.,240.,08.*           I                                I
PAR,96,30.0000,06.,240.,08.*           I                                I
PAR,97,42.0000,12.,240.,10.*           I                                I
PAR,98,01.0080,01.,001.,0.0*           --------                 --------
PAR,21,0.73,0.03,1.0*                --------                   --------
PAR,22,1.33,1.03,2.0*                I                                  I
PAR,23,2.67,2.03,3.0*                I                                  I
PAR,24,5.00,3.03,6.0*                I                                  I
PAR,25,10.00,6.03,12.0*              I        PARAMETERS BY WHICH       I
PAR,26,14.00,12.03,15.0*             I   ACTUAL SENTENCE TO BE SERVED   I
PAR,27,16.00,15.03,18.0*             I           IS CALCULATED          I
PAR,28,22.00,18.03,24.0*             I        (PARAMETERS 21-32)        I
PAR,29,27.00,24.03,36.0*             I                                  I
PAR,30,48.00,36.03,60.0*             I                                  I
PAR,31,84.00,60.03,120.0*            I                                  I
PAR,32,156.00,120.03,360.0*          --------                   --------
ACT,1,13,CO,0.0,13*
ACT,2,13,CO,0.0,14*
ACT,3,13,CO,0.0,15*
ACT,4,13,CO,0.0,16*
ACT,5,13,CO,0.0,17*
ACT,6,13,CO,0.0,18*
ACT,7,13,CO,0.0,19*
ACT,8,13,CO,0.0,20*
ACT,9,13,CO,0.0,21*
ACT,10,13,CO,0.0,22*
ACT,11,13,CO,0.0,23*
ACT,12,13,CO,0.0,24*
ACT,13,14,,,25/SUMM-CM,,1,A2.EQ.1.0*
ACT,13,15,,,26/SPEC-CM,,2,A2.EQ.2.0*
ACT,13,16,,,27/SBCD-CM,,3,A2.EQ.3.0*
ACT,13,17,,,28/GENE-CM,,4,A2.EQ.4.0*
ACT,13,18,,,29/NONE-CM,,5,A2.EQ.5.0*
ACT,14,19,CO,0,30*
ACT,15,19,CO,0,31*
ACT,16,19,CO,0,32*
ACT,17,19,CO,0,33*
ACT,18,91,CO,0,34*
ACT,19,20,CO,0,35/NO CONF,,1,A3.LE.0.00*   ----   NO CONFINEMENT   ----
ACT,19,21,CO,0,36/IDF FAC,,2,A3.LE.1.00*   I  TO AN IDF FOR CONFMN'T  I
ACT,19,22,CO,0,37/ACA FAC,,3,A3.LE.12.0*   I   TO ACA FOR CONFMN'T    I
ACT,19,25,CO,0,38/ BD FAC,,4,A3.GT.12.0*   ----  TO DB FOR CONFMN'T ----
ACT,20,92,CO,0,39/CM-NOCON*
ACT,21,28,UF,4,58/IDF-FAC,13*    SERVING TIME IN IDF (13 SERVERS)
ACT,22,28,UF,4,59/ACA-FAC,18*        SERVING TIME IN USACA (18 SERVERS)
ACT,23,24,CO,0.0,40/BALK-ACA,1*          BALKER AT THE USACA (1 SERVERS)
ACT,24,22,CO,1.0,41/BALK-DEL,,1,A5.GT.1.0*   ACA BALKER BEING DELAYED
ACT,24,93,CO,0.0,42/BALK-LEA,,2,A5.LE.1.0*   ACA BALKER LEAVING SYSTEM
ACT,25,28,UF,4,60/ADB-FAC,24*        SERVING TIME IN USADB (24 SERVERS)
ACT,26,27,CO,0.0,43/BALK-DB ,2*          BALKER AT THE USDB (2 SERVERS)
ACT,27,25,CO,1.0,44/BALK-DEL,,1,A5.GT.1.0*   DB  BALKER BEING DELAYED
ACT,27,94,CO,0.0,45/BALK-LEA,,2,A5.LE.1.0*   DB  BALKER LEAVING SYSTEM
ACT,28,29,CO,0.0,46/IDF   ,,2,A3.LE.1.03333*
ACT,28,30,CO,0.0,47/ACA 1,,3,A3.LE.2.03333*
ACT,28,31,CO,0.0,48/ACA 2,,4,A3.LE.3.03333*
ACT,28,32,CO,0.0,49/ACA 3,,5,A3.LE.6.03333*
ACT,28,33,CO,0.0,50/ACA 4,,6,A3.LE.12.03333*
ACT,28,34,CO,0.0,51/DB  1,,7,A3.LE.15.03333*
ACT,28,35,CO,0.0,52/DB  2,,8,A3.LE.18.03333*
ACT,28,36,CO,0.0,53/DB  3,,9,A3.LE.24.03333*
ACT,28,37,CO,0.0,54/DB  4,,10,A3.LE.36.03333*
ACT,28,38,CO,0.0,55/DB  5,,11,A3.LE.60.03333*
ACT,28,39,CO,0.0,56/DB  6,,12,A3.LE.120.03333*
ACT,28,40,CO,0.0,57/DB  7,,13,A3.GT.120.03333*
TIM,1,2,3,4,5*                --------                               --------
TIM,6,7,8,9,10*               I   USER COLLECTED TIME PERSISTANT VARIABLE   I
TIM,11,12,13,14,15*           --------                               --------
COL,1,2,3,4,5*                --------                               --------
COL,6,7,8,9,10*               I          USER COLLECTED STATISTICS          I
COL,11,12,13,14,15*           --------                               --------
FIN*
```

ANNEX II TO APPENDIX D

DATA INPUT DESCRIPTION FOR Q-GERT NETWORK CARDS

GEN - general project information

Field Number	Description	Value	Default	Editing	Associated Errors
1	Card type	GEN	(Required)	= 'GEN'	8101
2	Analyst name	Alpha field (up 12 significant characters)	12 blanks	If present, first character must be alphabetic (only first 12 characters are processed)	102
3	Project name or number	Alpha field	12 blanks	(see previous field)	103
4	Month	Integer	1	Integer between 0 and 12	104
5	Day	Integer	1	Integer between 0 and 31	105
6	Year	Integer	2001	Integer between 1970 and 2001	106
7	Number of STAtistics nodes	Integer	0	Integer between 0 and maximum number of nodes	107
8	Number of SINk nodes	Integer	0	Integer between 0 and maximum number of nodes	108
9	Number of SINk node releases to end a run	Integer	value in Field 8	Integer	109
10	Time to end one run of the network	Real	1.E30	Positive real	110
11	Number of runs of the network	Integer	1	Positive integer	111
12	Indicator for output reports in addition to the final summary report	First Run, Each Run, Cumulative & Each Run, Summary Only	First	= 'F' or 'E' or 'C' or 'S' (LAST)	112
13	Time from which statistics will be kept on each run	Real	0	Non-negative real	113
14	Maximum number of attributes with each transaction flowing through the network	Integer	0	Non-negative integer	114
15	Run number for beginning of event tracing	Integer	0→no tracing	Integer between 0 and value of Field 11	115
16	Run number for ending of event tracing (this run will be traced)	Integer	Value of Field 15	Integer between value of Field 15 and value of Field 11	116
17	Run number for beginning of nodal tracing	Integer	0→no tracing	Integer between 0 and value in Field 11	115
18	Run number for ending of nodal trace (this run is traced)	Integer	Value in Field 17	Integer between value in Field 17 and value in Field 11	116
19	Indicator that only input cards with errors are to be listed	Errors only All cards	All input cards listed	= 'E'	119
20	Execution option	E1 — No execution E2 — No execution if any input discrepancies E3 — No execution if fatal input discrepancy	E3	= 'E1', 'E2', 'E3', or 'E4' (E4 — Echo suppressed)	120
21	Largest node number defined by user. (Specify only when including subnetworks.)	Integer	MXNOD	Integer	
22	Largest activity number defined by user. (Specify only when including subnetworks).	Integer	MXNPO	Integer	

***QUE* - *queue* node description**

Field Number	Description	Value	Default	Editing	Associated Errors
1	Card type	QUE	(Required)	= 'QUE'	8000
2	Node number/Label for output identification	Integer /8 characters	(Required)/ Blanks	Integer between 1 and maximum number of nodes	8002
3	Initial number in queue	Integer	0	Non-negative integer	403
4	Maximum number permitted in queue	Integer (to specify infinite, use default)	Infinite	Non-negative integer	404
5	Output characteristics of node	*D*eterministic *P*robabilistic	*D*eterministic	= 'P' or 'D'	205
6	Ranking procedure for Q-node/	*F*IFO-first in-first out *L*IFO-last in-first out *S*mall value first (based on attribute value) *B*ig value first (based on attribute value)	*F*IFO	= 'F', 'L', 'S', or 'B'	406
	For Q-nodes ranked by *S*mall or *B*ig, the number of the attribute on which the ranking is based	Integer or *M*ark Time	*M*ark Time	Integer between 1 and maximum number of attributes or 'M'	7207
7	Balking or blocking information	*B*locking or Integer = node number to which balkers are sent	Balkers are lost to system	= 'B' or integer between 1 and maximum number of nodes	407 8407 8408 8409
8	The upper limit of the first cell for the histogram to be obtained for this node.	Real or 'N'	N → no reporting of statistics	Real or 'N'	
9	The width of each cell of the histogram. Each histogram contains 20 cells.	Real or 'N'	N → no reporting of statistics	Positive Real or 'N'	
10-31	Selector nodes or the MATCH node on output side of Q-node (if any) (but not if a service activity emanates from the Q-node) When more than one S-node is specified, the order of appearance in these fields determines the priority given to the associated S-nodes.	Integer	No S-node or MATCH node on output side of Q-node	Integer between 1 and maximum number of nodes	8410 8411

REG-regular node description or *SOU*-source node description

Field Number	Description	Value	Default	Editing	Associated Errors
1	Card type	*REG* or *SOU*	(Required)	= 'REG' or 'SOU'	8000
2	Node number	Integer	(Required)	Integer between 1 and maximum number of nodes	8002
3	Initial number of incoming transactions to release the node.	Integer	1 if *REG* 0 if *SOU*	Non-negative integer (0 if and only if *SOU*)	8003
4	Subsequent number of incoming transactions to release the node (after the first release)	Integer (to specify infinite, use default)	Infinite	Positive integer	8003
5	Output characteristics of node	*P*robabilistic *D*eterministic *F*irst (conditional, take first) *A*ll (conditional, take all)	Deterministic	= 'P', 'D', 'F', or 'A'	206
6	Indicator that this node is to mark	*M*ark	M if SOU No M if REG = 'M'		206
7	Criterion for associating an attribute set with a transaction passing through a node/	Hold the attribute set of the transaction arriving *F*irst *L*ast or hold attribute set of the transaction with the *S*mallest value in a given attribute *B*iggest value in a given attribute	*L*ast	= 'F', 'L', 'S', or 'B'	207
	If *S*mall or *B*ig specified, the number of the attribute to be used or 'M' for mark time	Integer or 'M'	*M*ark Time	Integer between 1 and maximum number of attributes specified for a transaction or 'M'	7207

VAS - value assignments to attributes of transactions

Field Number	Description	Value	Default	Editing	Associated Errors
1	Card type	VAS	(Required)	= 'VAS'	8000
2	Node number at which assignment is to be made	Integer	(Required)	Integer between 1 and maximum number of nodes	8002 8012
3	Number of the attribute to which the assignment is to be made	Integer	1	Integer between 1 and maximum number of attributes	8003
4	Distribution or function type for the assignment	2 character ID chosen from list of distribution types (Table A1)	*CO*	= 2 character ID from Table A1	804
5	Parameter set number for the assignment	Integer or Real	0.0	Integer or Real	805
6-26	(Repeat Fields 3, 4, and 5 to specify up to 7 additional assignments. Use only 1 *VAS* input card for each node at which assignments take place)				806 8007

. *ACT - Activity description*

Field Number	Description	Value	Default	Editing	Associated Errors
1	Card Type	ACT	(Required)	= 'ACT'	9001
2	Start node	Integer	(Required)	Number of an existing node	9002
3	End node	Integer	(Required)	Number of an existing node (not an assembly node)	9003
4	Distribution or function type	2 character ID chosen from list of distribution types (Table A1)	*CO*	= 2 character ID from Table A1	1004
5	Parameter set number or value of constant	Integer or Real	0.0		1005
6	Activity number/	Integer	System-assigned	Integer between 0 and maximum number of activity numbers	1006 9006 9105
	Label for server identification	8 characters	Blank		
7	The number of servers represented by this branch	Integer	1	Non-negative integer	1007 9007
8 or	Probability (only applicable if start node has 'P' branching or start node is a SELector using RFS rule)	Real number between 0. and 1. or attribute number where probability is stored	0.5	Real number between 0. and 1. or non-negative integer	1008 9008
8	Order of testing conditions (only applicable if start node has 'F' branching* or start node is a SELector using POR rule**)	Non-negative number (integer or real)	0 (= conditions tested in order of input	Non-negative number	9008
9	Condition code (only applicable if start node has 'F' or 'A' branching)	See Condition Codes List***	Start node released (Ni.R).		1009 9009 9010 9011

* For each activity emanating from a start node with F (conditional, take first) output, an order value should be specified. When the start node is released, conditions on associated branches will be tested in ascending order (low values first) based on this value.

** The "preferred order" for selection from free servers in ascending order (low value first) based on this value.

*** Condition codes allowed are:

T.ℛ.V	Time ℛ. Value
T.ℛ.Ak	Time ℛ. Attribute k
Aj.ℛ.V	Attribute j.ℛ.Value
Aj.ℛ.Ak	Attribute j.ℛ.Attribute k

where ℛ={LT;LE;EQ;NE;GT; or GE}

Ni.R	Node i Released
Ni.N	Node i Not Released
NAj.R	Node Aj Released
NAj.N	Node Aj Not Released

PAR* - *parameter set description

Field Number	Description	Value	Default	Editing	Associated Errors
1	Card type	PAR	(Required)	= 'PAR'	8000
2	Parameter set number	Integer	(Required)	Integer between 1 and maximum number of parameter sets	8002
3	Parameter 1	Real	0.	Real	903
4	Parameter 2	Real	-10^{30}	Real	903
5	Parameter 3	Real	10^{30}	Real	903
6	Parameter 4	Real	0.	Real	903
7	Random Number Stream	Integer	MXSTR=10	Integer	903

A sample is obtained from a distribution such that if a sample is less than the minimum value, the sample value is given the minimum value. Similarly, if the sample is greater than the maximum value, the sample value is assigned the maximum value. This is not sampling from a truncated distribution but sampling from a distribution with a given probability of obtaining the minimum and maximum values.

The parameters required to sample from the distributions are described below. The parameter values for the lognormal (LO), triangular (TR), beta (BE), gamma (GA), and beta PERT (BP) are modified to simplify random sampling. Thus, parameter sets for these distributions must not be used for any other distributions, i.e., a parameter set for a lognormal distribution must only be used for sampling from a lognormal distribution.
For COnstants, no PAR card is used. The value of the constant is taken as the value given to parameter set specification.

For NOrmal, LOgnormal, BEta, and GAmma distributions

Parameter 1	The mean value
Parameter 2	The minimum value
Parameter 3	The maximum value
Parameter 4	The standard deviation

For UNiform distribution

Parameter 1	Not used
Parameter 2	The minimum value
Parameter 3	The maximum value
Parameter 4	Not used

For EXponential distribution

Parameter 1	The mean value
Parameter 2	The minimum value
Parameter 3	The maximum value
Parameter 4	Not used

For ERlang distribution

Parameter 1	The mean time for the Erlang variable divided by the value given to Parameter 4
Parameter 2	The minimum value
Parameter 3	The maximum value
Parameter 4	The number of exponential deviates to be included in the sample obtained from the Erlang distribution

For POisson distribution

Parameter 1	The mean minus the minimum value
Parameter 2	The minimum value
Parameter 3	The maximum value
Parameter 4	Not used

Care is required when using the *PO*isson since it is not usually used to represent an interval of time. The interpretation of the mean should be the mean number of time units per time period.

For BP and TRiangular distribution

Parameter 1	The most likely value m
Parameter 2	The optimistic value a
Parameter 3	The pessimistic value b
Parameter 4	Not used

SIN - *sink* node description or *STA* - *statistics* node description

Field Number	Description	Value	Default	Editing	Associated Errors
1	Card type	SIN or STA	(Required)	= 'SIN' or 'STA'	8009
2	Node number/Label for output identification	Integer/8 characters	(Required)/ Blanks	Integer between 1 and maximum number of nodes	8002
3	Initial number of incoming transactions to release the node	Integer	1	Positive integer	8003
4	Subsequent number of incoming transactions to release the node (after the first release)	Integer (to specify infinite, use default)	Infinite	Positive integer	8003
5	Output characteristics of node	*P*robabilistic *D*eterministic *F*irst (conditional, take first) *A*ll (conditional, take all)	*Deterministic*	= 'P', 'D', 'F', or 'A'	205
6	Statistical quantities to be collected	*F*irst (time of first release) *A*ll (time of all releases) *B*etween (time between releases) *I*nterval (time interval from most recent marking of transaction to release of this node) *D*elay (delay from first arriving transaction until the node is released)	*First*	= 'F', 'A', 'B', 'I', or 'D'	206
7	The upper limit of the first cell for the histogram to be obtained for this node. The first cell of the histogram will contain the number of times the statistic of interest at this node had a value less than or equal to the value given in this field.	Real or 'N'	N → no reporting of statistics	Real or 'N'	
8	The width of each cell of the histogram. Each histogram contains 20 cells. The last cell will contain the number of times the statistic of interest at this node had a value greater than the upper limit of the first cell (Field 7) plus 18 x cell width (Field 8).	Real or 'N'	N → no reporting of statistics	Positive real or 'N'	
9	Criterion for associating an attribute set with a transaction passing through a node /	Hold the attribute set of the transaction arriving *First* *Last* or hold attribute set of the transaction with the *S*mallest value in a given attribute *B*iggest value in a given attribute	*Last*	= 'F', 'L', 'S', or 'B'	208
	If *Small* or *Big* specified, the number of the attribute to be used or 'M' for mark time	Integer or *Mark* Time	*Mark* Time	Integer between 1 and maximum number of attributes specified for a transaction or 'M'	7207

MAT - *mat*ch node description

Field Number	Description	Value	Default	Editing	Associated Errors
1	Card Type	*MAT*	(Required)	= 'MAT'	8000
2	Node Number	Integer	(Required)	Integer between 1 and maximum number of nodes	8002
3	Matching attribute Number or M for mark time	Integer or *M*ark Time	*M*ark Time	Integer between 1 and maximum number of attributes for the simulation or 'M'	7207
4	Q-nodes containing transactions to be matched by this match node (up to 5 Q-nodes are allowed)/	Integer		at least 2 Q-nodes associated with the Match node	8804
	Node number to which a matched transaction from Q-node is to be routed	Integer	No routing		
5-8	Repeats of Field 4. At least 1 repeat required and at most 4 repeats allowed.				8805

TIM - *Tim*e-persistent statistics (required only if calls to subroutine TIM are employed in UF)

Field Number	Description	Value	Default	Editing	Associated Errors
1	Card type	TIM	(Required)	= 'TIM'	8000
2	Numeric code, II, used to identify all statistics resulting from calls to subroutine TIM(XX,II) with the same second argument. This code must be unique among all TIM statistics/	Integer	(Required)	Non-negative integer less than or equal to MUTIM	9222
	Alphanumeric label for identification of TIM statistics	Alphanumeric	Blanks	Alphanumeric	
3	Initial value for the variable associated with the numeric code in Field 2.	Real	0.	Real	9223
4-15	(Repeat Fields 2 and 3 to specify up to 7 TIM type statistics per TIM card. Additional TIM cards may be used.)				

COL = *Collect* statistics based on observation (required only if calls to subroutine COL are employed in UF)

Field Number	Description	Value	Default	Editing	Associated Errors
1	Card type	COL	(Required)	= 'COL'	8000
2	Numeric code, I, used to identify the statistics resulting from calls to subroutine COL(X,I) with the same second argument. This code must be unique among all COL statistics/	Integer	(Required)	Non-negative integer less than or equal to MUCOL	9222
	Alphanumeric label for identification of COL statistics	Alphanumeric	Blanks	Alphanumeric	
3-8	(Repeat Field 2 to specify up to 7 COL type statistics per COL card. Additional COL cards may be used				

FIN - *finish* of all networks

Field Number	Description	Value	Default	Editing	Associated Errors
1	Card type	*FIN*	(A blank card may be used in lieu of *FIN* card)	Blank card or = 'FIN'	1301 8000

APPENDIX E

USER MANUAL FOR THE ARMY PRISONER MANAGEMENT MODEL (PRISM)

E-1. INTRODUCTION. The PRISM model was designed to facilitate user applications for management decisions concerning the Army Correctional System. All data entries which must be varied and input by the user are external inputs to the model. Thus, recompilation and recollection of the FORTRAN subrountines are not necessary. The user needs only to change the desired input data, located in the Q-GERT model network file and the data input file, to execute the program. The software through which the user may affect the operation of the model includes the Q-GERT subroutines, the PRISM network data file, and the data input file.

E-2. MODEL SUBROUTINES

a. It is possible for a programer familiar with FORTRAN to make changes or modifications to the Q-GERT code or to expand the capabilities of the basic Q-GERT software. This model is designed to operate within an expanded version of Q-GERT. Program QGERT and subroutines PROC 1, UI, UF, and UO identify all of the common blocks, dimension statements, and identities which may require modification in order to expand the capabilities of the Q-GERT software package and the model.

b. Subroutine PROC 1 contains the set of common blocks used throughout the model. This set is passed to all other subroutines (by an INCLUDE statement) except subroutines UI, UF, and UO. The common block used in these three subroutines is only necessary for use with the code written specifically for the operation of PRISM.

c. Subroutine UF (User Function) is the subroutine which contains PRISM specific decision and assignment actions. It accomplishes those model design tasks which the general process of the Q-GERT Analysis Program does not accomplish.

d. Subroutine UI (User Input) contains the code for reading and processing the user input data, rates, and probabilities contained in the input data file for the model.

e. Subroutine UO (User Output) contains the code necessary for the production of user designed output reports.

f. Program QGERT is the main operating program and determines the maximum network size. The Q-GERT (expanded) used at the US Army Concepts Analysis Agency (CAA) has the capability to model 999 nodes in addition to other expanded capabilities. The dimensioning statements for the expanded version used at CAA are contained in subroutine PROC 1.

g. If the user desires to make changes to any subroutine other than PROC 1, recompilation of the subroutine which was changed and recollection of the entire model is necessary. If changes are made to PROC 1, recompilation and recollection of the entire model is necessary.

E-3. INPUT FILES

a. There are two files whereby the user can set the input variables to the model for use by the Q-GERT Analysis Program. These files are the data input file and the PRISM network data file.

b. The data input file contains the set of data elements which establishes the conditions under which the model will generate transactions and make decisions to route those transactions through the model network. The data input file currently contains 40 data records to be input by the user. A summary description of these data records and the formats for the records are provided at Annex I. These data records are used as input to build several arrays for use by the model.

(1) The data array CUMP (Cumulative Probability Distributions) contains the cumulative probability distribution that an offender committing a given offense will be tried by a particular level of court-martial. CUMP is a 12x5 array where the element CUMP (I,J) reflects the cumulative probability that offense type i will be tried at court-martial j: where i=1,12 and j=1,5. The 12 offense categories are presented in Table E-1 and the 5 levels of court-martial are presented in Table E-2. Each row represents a cumulative probability distribution. Example:

```
CUMP 01    0.00    0.00    0.05    1.00   1.00
```

In this case, offense category 1 is as shown in Table E-1. There is a .05 probability that an offender, committing offense type 1, will be tried at a Special (BCD) court-martial and a .95 probability that the offender will be tried at a General court-martial. There is a zero probability for the offender being tried at any other level. Another example is:

```
CUMP 07    0.15    0.60    0.95    0.95    1.00
```

In this case, an offender of military duty avoidance has a 0.15 probability of being tried by Summary court-martial, 0.45 probability for Special court-martial, 0.35 probability for General court-martial and a 0.05 probability of not going to court-martial. The format for entering a CUMP record is included in Annex I.

Table E-1. Offense Categories

Category number	Offense(s)
1	Murder/manslaughter/other capital offenses
2	Carnal knowledge/kidnapping/other major offenses
3	Robbery/agg assault/larceny
4	Housebreaking/burglary/auto related offenses
5	AWOL/desertion
6	Military misconduct/disrespect
7	Military duty avoidance
8	Military disturbance/simple assault
9	Neglect, abuse, distruction of Govt property
10	Marihuana related offenses (use/poss)
11	Other drug related offenses
12	Miscellaneous

Table E-2. Court-Martial Levels

Level number	Type of court-martial
1	Summary Court-Martial
2	Special Court-Martial
3	Special (BCD) Court-Martial
4	General Court-Martial
5	No Court-Martial

(2) The data array NOCONF (No Confinement) contains the probabilities that an offender being tried for a particular offense type at a specific court-martial level will recieve a sentence of no confinement. This array is a 12x4 array where NOCONF (i,j) represents the probability that offense type i will receive no confinement from court-martial level j. An example of this input is:

NOCONF 05 0.04 0.02 0.01 0.00

In this case, offense type 5 will draw a sentence of no confinement with probabilities 0.04 from a Summary court-martial, 0.02 from a Special court-martial, 0.01 from a Special (BCD) court-martial and 0.00 from a General court-martial. The format for entering a record of this type is included in Annex I.

(3) The data array SENPAR (Sentencing Distribution Parameter Card Identifier) is a 12x4 array containing the parameter set identifier which refers to a particular PAR card in the model network data cards. (These PAR cards are more fully explained in Appendix D.) The parameter set number contained in SENPAR (i,j) identifies the parameter set to be used in generating the sentence to confinement which will be awarded to offense type i from court-martial level j. This calculation of a sentence is performed within subroutine UF at statement 2. The parameters are applied to a probability distribution function to stochastically draw a sentence length from the distribution of sentence lengths described by these parameters. The crime types have sentences drawn from a conditional Gaussian distribution with parameters specified by SENPAR. The PAR cards used for carrying the parameter sets for this purpose are set numbers 51-98, one set for each crime type tried at each level of court-martial; that is, each (i,j) of SENPAR contains a parameter set number where SENPAR (1,1) contains the set number 51 and SENPAR (12,4) contains the set number 98. It is unlikely that the user will be adjusting this array. If it is desired to evaluate the impact of varying sentence lengths on the prisoner population, it would be more appropriate to adjust the parameters (contained on the PAR cards) of the distributions. The format for entering a data record of this type is included in Annex I.

(4) The variable CLEMCY represents the probability that a prisoner serving a sentence to confinement will benefit from action by the clemency/parole board. In accordance with current regulations only a prisoner serving a sentence greater than 1 year is eligible for clemency/parole board action. A different set of rules is applied for clemency action for prisoners with a sentence of 1-3 years and for those with sentences of greater than 3 years.

(5) Data array CONPAR (Confinement Parameter Identifiers) contains parameter set identifiers (relating to PAR cards of the model network input data) similar to the SENPAR array described above. CONPAR is a 1x12 array containing the parameter set numbers which identify the parameters used by an exponential probability distribution for generating the actual sentence to be served for a given sentence category after accounting for accrual of good-conduct time. The effect is to generate a reduced sentence to be served from that which was approved. The calculation is made within subroutine UF at statement 4. The PAR cards carrying the parameter sets used for this purpose are set numbers 21-32 and are identified as shown in Table E-3. As with SENPAR, it is unlikely that the user will adjust this input.

Table E-3. Parameter Sets for CONPAR

Sentence category number	PAR card set number	Sentence length category
1	21	0-1 month
2	22	1-2 months
3	23	2-3 months
4	24	3-6 months
5	25	6-12 months
6	26	12-15 months
7	27	15-18 months
8	28	18-24 months
9	29	2-3 years
10	30	3-5 years
11	31	5-10 years
12	32	10+ years

If it is desired to assess the impact of different good-conduct time accrual programs it would be more appropriate to adjust the parameters contained in the PAR cards 21-32 themselves.

(6) The variable MAXIDF represents the upper bounding sentence-length category for confinement at an IDF. Since current policy specifies that prisoners serving sentences of 0-30 days will be confined at an IDF, the upper bounding sentence length category, as shown in Table E-3, is the first category. MAXIDF, then, is the value 1.

(7) Variable MAXACA represents the upper bounding sentence-length category for confinement at USACA. Current policy also specifies that all prisoners with sentences of 31 days to 1 year will be confined at USACA. Since the 6-12 month category is the fifth sentence length category, MAXACA is input as the value 5.

c. The PRISM network data file contains the input records which fully describe the model to the Q-GERT Analysis Program. The current version of PRISM contains 242 records necessary to describe the model and direct the Q-GERT software package to accomplish the various tasks necessary to operate the model and generate the desired output reports. The user must change some of the PAR cards in order to exercise the model to assess variations in many of the rates and probabilities as was explained above.

(1) As explained previously, arrays SENPAR and CONPAR merely contain pointers to the PAR cards which actually hold the parameter sets for use by the probability distribution functions. In order to evaluate the effects of varying these probability distribution parameters on the prisoner population workloads, the parameters must be changed on the PAR cards. The explanation of the fields of the PAR card is contained in Annex II of Appendix D.

(2) A set of PAR cards, not explained above but also subject to adjustment by the user, are PAR cards 1-12. These cards contain the parameters for the generation of inter-arrival times for scheduling the arrivals of offenders into the system (the commission of offenses). The parameters on these cards reflect the rates at which offenses are committed.

E-4. OUTPUT REPORTS. Output reports from PRISM consist of two basic types. The first are those reports designed specifically for the Army Correctional System managers. The second are the automatically generated output reports from the Q-GERT analysis of the system being modeled.

a. The two reports designed for the ACS managers are provided in Annex III and are fully explained in Chapter 5, paragraph 5-2.

b. Samples of the Q-GERT automated reports are also provided in Annex III.

ANNEX I to APPENDIX E

SUMMARY DESCRIPTIONS OF INPUT DATA ELEMENTS

Data element	Description	Format type
CUMP	A 12x5 array containing cumulative probability vectors for each of the 12 offense types. The 5 vector positions represent the 5 levels of court-martial modeled. CUMP (i,j) is the cumulative probability that offense type i will be tried by court-martial level j or a lower court (j=5 represents no court-martial).	1
NOCONF	A 12x4 array containing the probabilities that offense type i will receive a sentence of no confinement when tried by court-martial level j. NOCONF contains 12 records of 4 data fields.	1
SENPAR	A 12x4 array containing the numbers (identifiers) of the PAR card parameter sets used to describe the probability distribution functions from which an approved sentence will be drawn. One PAR card identifier for each offense type i tried at court-martial level j.0).	2
CLEMCY	A variable identifying the probability that a prisoner serving confinement will benefit from clemency/parole board action.	3
CONPAR	A vector (1x12 array) containing the numbers (identifiers) of the PAR cards parameter sets describing the particular exponential probability distribution function used to determine the actual confinement time to be served after accounting for accrual of good conduct time.	4

Data element	Description	Format type
MAXIDF	A variable identifying the number (1-12) of the upper-bounding sentence length category for confinement at an IDF.	5
MAXACA	A variable identifying the number (1-12) of the upper-bounding sentence length category for confinement at the USACA.	5

Figure E-I-1. Format 1

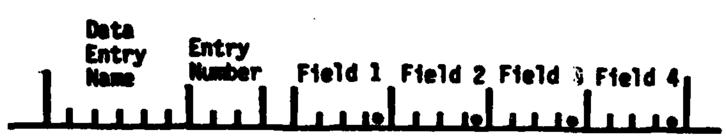

Figure E-I-2. Format 2

Figure E-I-3. Format 3

Figure E-I-4. Format 4

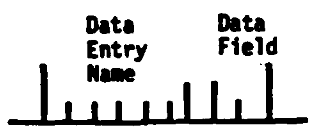

Figure E-I-5. Format 5

ANNEX II TO APPENDIX E

VARIABLE INPUT DATA TO PRISM

```
 1      CUMP     1  0.00 0.00 0.07 1.00 1.00
 2      CUMP     2  0.00 0.07 0.31 1.00 1.00
 3      CUMP     3  0.00 0.16 0.62 1.00 1.00
 4      CUMP     4  0.00 0.18 0.68 1.00 1.00
 5      CUMP     5  0.00 0.37 0.82 1.00 1.00
 6      CUMP     6  0.00 0.35 0.84 1.00 1.00
 7      CUMP     7  0.00 0.29 0.86 1.00 1.00
 8      CUMP     8  0.00 0.27 0.80 1.00 1.00
 9      CUMP     9  0.00 0.20 0.79 1.00 1.00
10      CUMP    10  0.00 0.14 0.70 1.00 1.00
11      CUMP    11  0.00 0.08 0.47 1.00 1.00
12      CUMP    12  0.95 0.95 0.95 0.95 1.00
13      NOCONF   1  0.00 0.00 0.00 0.00
14      NOCONF   2  0.00 0.00 0.03 0.01
15      NOCONF   3  0.00 0.00 0.03 0.01
16      NOCONF   4  0.00 0.00 0.04 0.02
17      NOCONF   5  0.00 0.00 0.02 0.00
18      NOCONF   6  0.00 0.00 0.03 0.01
19      NOCONF   7  0.00 0.00 0.04 0.02
20      NOCONF   8  0.00 0.00 0.04 0.01
21      NOCONF   9  0.00 0.00 0.04 0.01
22      NOCONF  10  0.00 0.00 0.02 0.01
23      NOCONF  11  0.00 0.00 0.01 0.00
24      NOCONF  12  0.00 0.00 0.00 0.00
25      SENPAR   1  51. 63. 75. 87.
26      SENPAR   2  52. 64. 76. 88.
27      SENPAR   3  53. 65. 77. 89.
28      SENPAR   4  54. 66. 78. 90.
29      SENPAR   5  55. 67. 79. 91.
30      SENPAR   6  56. 68. 80. 92.
31      SENPAR   7  57. 69. 81. 93.
32      SENPAR   8  58. 70. 82. 94.
33      SENPAR   9  59. 71. 83. 95.
34      SENPAR  10  60. 72. 84. 96.
35      SENPAR  11  61. 73. 85. 97.
36      SENPAR  12  62. 74. 86. 98.
37      CLFMCY 0.003
38      CONPAR      21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32.
39      MAXIDF   1
40      MAXACA   5
```

ANNEX III TO APPENDIX E

PRISM OUTPUT REPORTS

***** RESULTS BASED ON SIMULATION 2 *****

**** CONFINEMENT TIME SERVED BY SENTENCE LENGTH CATEGORY ****

SENTENCE CATEGORY	AVE CONF TIME (MONTHS)	STD DEV	SD OF AVE	MINIMUM	MAXIMUM	NO OF OBS
C- 1 MONTH	.4617	.2796	.0073	.0300	1.0000	1468
1- 2 MONTHS	1.3297	.3695	.0385	1.0300	2.0000	92
2- 3 MONTHS	2.1619	.2313	.0247	2.0300	3.0000	88
3- 6 MONTHS	3.5403	.6662	.0497	3.0300	6.0000	180
6-12 MONTHS	7.7255	2.1067	1.0533	6.0300	10.3737	4
12-15 MONTHS	12.5144	.0000	.0000	12.5144	12.5144	1
15-18 MONTHS	15.6815	1.0050	.3178	15.0300	17.7166	10
18-24 MONTHS	18.7394	1.0404	.2686	18.0300	21.0772	15
2- 3 YEARS	26.9498	3.8177	.8139	24.0300	34.1856	22
3- 5 YEARS	40.2063	5.8246	1.3729	36.0300	54.2258	18
5-10 YEARS	61.3479	1.5776	.9108	60.0300	63.0959	3
10+ YEARS	NO VALUES RECORDED					

**** CONFINEMENT TIME SERVED AT SPECIFIC FACILITY ****

CONFINEMENT FACILITY	AVE CONF TIME (MONTHS)	STD DEV	SD OF AVE	MINIMUM	MAXIMUM	NO OF OBS
IDF	.4617	.2796	.0073	.0300	1.0000	1468
USACA	2.6943	1.2153	.0637	1.0300	10.3737	364
USDB	28.2764	12.1224	1.4594	12.5144	63.0959	69

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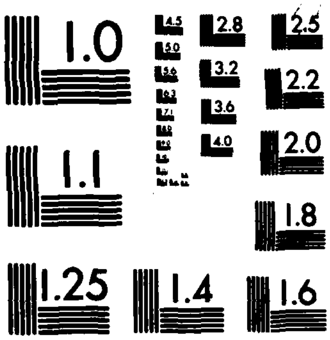

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

***** AVERAGE DAILY PRISONER POPULATIONS WITHIN EACH SENTENCE LENGTH CATEGORY *****

SENTENCE CATEGORY	AVE DAILY POPULATION	STD DEV	MINIMUM	MAXIMUM	NO OF MONTHS SUMMARIZED
0- 1 MONTH	6.2971	1.9927	.0000	14.0000	72
1- 2 MONTHS	1.1511	1.0127	.0000	4.0000	72
2- 3 MONTHS	1.7831	1.1821	.0000	6.0000	72
3- 6 MONTHS	5.9302	2.4357	1.0000	13.0000	72
6-12 MONTHS	.2861	.4632	.0000	2.0000	72
12-15 MONTHS	.6379	1.8339	.0000	7.0000	72
15-18 MONTHS	1.1001	1.1698	.0000	3.0000	72
18-24 MONTHS	1.9041	.9153	.0000	4.0000	72
2- 3 YEARS	4.9976	1.6893	1.0000	8.0000	72
3- 5 YEARS	6.6441	3.0089	1.0000	11.0000	72
5-10 YEARS	5.0134	2.3854	1.0000	9.0000	72
10+ YEARS	2.2010	1.5529	1.0000	7.0000	72

***** AVERAGE DAILY PRISONER POPULATION AT SPECIFIC FACILITY *****

CONFINEMENT FACILITY	AVE DAILY POPULATION	STD DEV	MINIMUM	MAXIMUM	NO OF MONTHS SUMMARIZED
IDF	6.2971	1.9927	.0000	14.0000	72
USACA	9.1475	3.2152	1.0000	18.0000	72
USDB	21.2233	5.7111	1.0000	29.0000	72

NODE STATISTICS

NODE	LABEL	AVE.	NO OF OBS.	TYPE OF STATISTICS
91	NONE-CM	.0000	57.	I
92	CM-NOCON	.0000	669.	I
93	BALK ACA	NO VALUES RECORDED		
94	BALK DB	22.0000	1.	I
95	END CONF	2.2268	1255.	I

		NUMBER IN Q-NODE				** WAITING TIME ** IN QUEUE
NODE	LABEL	AVE.	MIN.	MAX.	CURRENT NUMBER	AVERAGE
21	IDFAC	.0003	0.	1.	0	.0000
23	USACA	.0000	0.	0.	0	.0000
26	USADB	.0000	0.	0.	0	.0000
29		.0000	0.	0.	0	.0000
30		.0000	0.	0.	0	.0000
31		.0000	0.	0.	0	.0000
32		.0000	0.	0.	0	.0000
33		.0000	0.	0.	0	.0000
34		.0000	0.	0.	0	.0000
35		.0000	0.	0.	0	.0000
36		.0000	0.	0.	0	.0000
37		.0000	0.	0.	0	.0000
38		.0000	0.	0.	0	.0000
39		.0000	0.	0.	0	.0000
40		.0000	0.	0.	0	.0000
41		6.3101	0.	14.	7	.4548
42		1.0694	0.	4.	2	1.2869
43		1.5825	0.	5.	2	2.1200
44		5.3181	1.	11.	2	3.4326
45		.2310	0.	1.	0	8.2018
46		.0000	0.	0.	0	.0000
47		.8040	0.	3.	0	8.1554
48		1.6826	0.	4.	1	9.1898
49		5.8146	3.	8.	5	17.2015
50		6.8920	3.	11.	3	23.3015
51		5.8755	3.	9.	8	37.9235
52		2.8268	1.	7.	7	28.6721

SERVER UTILIZATION

SERVER	LABEL	NO. PARALLEL SERVERS	AVE.	MAX. IDLE (TIME OR SERVERS)	MAX. BUSY (TIME OR SERVERS)
58	IDF-FAC	13	6.3101	13.0000	13.0000
59	ACA-FAC	18	8.2011	15.0000	17.0000
40	BALK-ACA	1SERVER NEVER USED			
60	ADB-FAC	24	23.8956	3.0000	24.0000
43	BALK-DB	2SERVER NEVER USED			

NO. BALKING PER UNIT TIME

NODE	LABEL	AVE.
22	USACA	.0000
25	USADB	8.7662

NODE	TRANSACTION PASSAGES
1	13
2	161
3	35
4	37
5	235
6	181
7	31
8	48
9	15
10	153
11	46
12	1033
13	1988
14	976
15	217
16	453
17	285
18	57
19	1931
20	669
21	976
22	219
23	0
25	59
26	594
27	594
28	1255
29	978
30	57
31	51
32	108
33	2
34	0
35	7
36	12
37	19
38	18
39	3
40	0
41	978
42	57
43	51
44	108
45	2
46	0
47	7
48	12
49	19
50	18
51	3
52	0
53	978
54	57
55	51
56	108
57	2
59	7
60	12
61	19
62	18
63	3
80	72
91	57
92	669
94	1
95	1255

ACTIVITY END TIME	END NODE	ACTIVITY NUMBER
108.01	10	10
108.02	28	58
108.03	25	44
108.04	5	5
108.06	25	44
108.08	25	44
108.08	12	12
108.08	4	4
108.09	28	58
108.10	25	44
108.11	25	44
108.18	25	44
108.21	6	6
108.22	28	58
108.22	28	59
108.24	2	2
108.27	25	44
108.35	25	44
108.36	28	58
108.37	26	58
108.41	8	8
108.46	28	59
108.48	28	58
108.65	25	44
108.70	25	44
108.76	28	58
108.80	28	59
108.93	28	59
108.97	25	44
109.00	80	80
109.17	3	3
109.30	28	60
109.52	28	59
110.06	28	59
110.11	11	11
110.33	1	1
110.44	7	7
112.68	28	60
112.86	9	9
112.99	28	60
114.93	28	60
115.48	28	60
117.14	28	60
120.45	28	60
121.67	28	60
122.00	28	60
122.02	28	60
122.24	28	60
124.56	28	60
125.61	28	60
129.26	28	60
132.73	28	60
141.31	28	60
147.41	28	60
165.42	28	60
168.25	28	60
169.81	28	60
204.84	28	60
213.97	28	60
221.41	28	60
273.73	28	60

AVERAGE NODE STATISTICS

NODE	LABEL	PROBABILITY	AVE.	STD.DEV.	SD OF AVE	NO. OF OBS.	MIN.	MAX.	STAT TYPE
91	NONE-CN	1.0000	.0000	.0000	.0000	2.	.0000	.0000	I
92	CN-NOCON	1.0000	.0000	.0000	.0000	2.	.0000	.0000	I
93	BALK ACA		NO VALUES RECORDED						
94	BALK DB	1.0000	21.8815	.1684	.1190	2.	21.7619	22.0000	I
95	END CONF	1.0000	2.2061	.0293	.0207	2.	2.1854	2.2268	I

		AVERAGE NUMBER IN Q-NODE					**AVERAGE WAITING TIME**			**NUMBER IN Q-NODE**
NODE	LABEL	AVE.	STD.DEV.	SD OF AVE	MIN.	MAX.	AVE.	STD.DEV.	SD OF AVE	MAX.
21	IDFAC	.0002	.0002	.0002	.0000	.0003	.0000	.0000	.0000	1.0000
23	USACA	.0000	.0000	.0000	.0000	.0000	.0000	1.4142	1.0000	.0000
26	USADB	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
29		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
30		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
33		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
34		.0000	.0000	.0000	.0000	.0000	.0000	1.4142	1.0000	.0000
35		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
36		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
37		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
38		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
39		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
40		.0000	.0000	.0000	.0000	.0000	.0000	1.4142	1.0000	.0000
41		6.2403	.0988	.0698	6.1705	6.3101	.9503	.0065	.0046	14.0000
42		1.0379	.0446	.0315	1.0063	1.0694	1.3175	.0433	.0306	4.0000
43		1.7036	.1712	.1210	1.5825	1.8246	2.0721	.0676	.0478	5.0000
44		6.9515	.8958	.6334	6.3181	7.5850	3.4226	.0141	.0100	12.0000
45		.2913	.0853	.0603	.2310	.3516	8.2628	.0850	.0601	2.0000
46		.0000	.0000	.0000	.0000	.0000	.0000	1.4142	1.0000	.0000
47		.4586	.4886	.3455	.1131	.8040	8.0927	.0886	.0627	3.0000
48		1.0213	.9353	.6613	.3600	1.6826	8.8546	.4740	.3352	4.0000
49		4.8537	1.3589	.9609	3.8928	5.8146	15.5105	2.3914	1.6910	8.0000
50		7.0535	.2284	.1615	6.8920	7.2150	22.7870	.7271	.5141	11.0000
51		7.3885	2.1398	1.5130	5.8755	8.9016	30.0280	2.9773	2.1053	10.0000
52		3.1507	.4580	.3238	2.8268	3.4745	31.9568	4.6452	3.2847	7.0000

			AVERAGE SERVER UTILIZATION						**EXTREME VALUES**	
SERVER	LABEL	NO. PARALLEL SERVERS	AVE.	STD.DEV.	SD OF AVE	NO. OF OBS.	MIN.	MAX.	MAX. IDLE (TIME OR SERVERS)	MAX. BUSY (TIME OR SERVERS)
58	IDF-FAC	13	6.2403	.0988	.0698	2.	6.1705	6.3101	11.0000	13.0000
59	ACA-FAC	16	8.9843	1.1077	.7832	2.	8.2011	9.7675	15.0000	16.0000
60	BALK-ACA	1	.0000	.0000	.0000	2.	.0000	.0000	71.0000	.0000
61	ADB-FAC	24	23.9263	.0435	.0308	2.	23.8956	23.9570	3.0000	24.0000
62	BALK-DB	2	.0000	.0000	.0000	2.	.0000	.0000	2.0000	1.0000

AVERAGE NO. BALKING PER UNIT TIME

NODE	LABEL	AVE.	STD.DEV.	SD OF AVE	NO. OF OBS.	MIN.	MAX.
22	USACA	.0000	.0000	.0000	2.	.0000	.0000
25	USADB	12.9789	6.5233	4.6127	2.	8.3662	17.5915

APPENDIX F

PROGRAMS AND SUBROUTINES

F-1. GENERAL. This appendix contains the listings of the programs and subroutines necessary to expand the capabilities of the basic Q-GERT software package and operate the Army Prisoner Management Model (PRISM). As stated earlier, Q-GERT is a proprietary package and is not transferable from one computer facility to another. A potential user of this model must have access to a facility which has Q-GERT installed. Information concerning acquisition of the Q-GERT software package is available from the address below:

Pritsker and Associates, Inc.
P. O. Box 2413
W. Lafayette, Indiana 47906

F-2. PROGRAM QGERT

```
C     PROGRAM QGERT (INPUT,OUTPUT,TAPE7,TAPE8,TAPE9,TAPE10,TAPE5=INPUT,TOGT
C     1APE6=OUTPUT)
      INCLUDE PROC1
      IFIN=0                                                        QGT   65
      NPRNT5=10
      NCRDR=5                                                       QGT   67
      NPRNT=6                                                       QGT   68
      NPRNT2=7                                                      QGT   69
      NPRNT4=8                                                      QGT   70
      MMPAK=10000                                                   QGT   71
      MXNMC=100                                                     QGT   72
      NPRNT3=9                                                      QGT   73
      MXNTR=50                                                      QGT   74
      MXNS2=100                                                     QGT   75
      MXNOD=200    @ WAS 100 RAB
      MXTRS=900                                                     QGT   77
      MAXDS=3600                                                    QGT   78
      MXSTA=200                                                     DEC    2
      MXQUE=50                                                      QGT   80
C     MXSER=MXQUE                                                   QGT   81
      MXSER=100    @   APRIL 7 1983    (100 SERVERS)  SMM
      MXRES=40                                                      QGT   82
      MMPES=500                                                     QGT   83
      MXABA=280                                                     QGT   84
      MXNPO=100
      MXVAS=200    @  WAS 100 RAB                                   QGT   86
      MXPAR=100                                                     QGT   87
      MXSOU=20                                                      QGT   88
      MXCEL=20                                                      QGT   89
      MXSTR=10                                                      QGT   90
      MXEVT=900    @ WAS 200 RAB
      RMXVA=1.E20                                                   QGT   92
      ID=200       @ WAS 100 RAB
      IM=6                                                          QGT   94
      IMM=IM-1                                                      QGT   95
      MUCOL=100    @      WAS 25 RMM (26 APR 83)
      MUTIM=100    @      WAS 25 RMM (26 APR 83)
      MUHIS=100    @      WAS 25 RMM (26 APR 83)
    1 CALL DATIN
      CALL GASP
      IF (IFIN.EQ.0) GO TO 1                                        QGT  101
      STOP                                                          QGT  102
C                                                                   QGT  103
      END                                                           QGT  104
```

F-3. PROCEDURE PROC1

```
PROC1 PROC
      COMMON /SPLIT/ IDEX,IDEX2,IERR,IFLG,IMATI,KARDNO,KKK,NNTR,NSKD,NOD
     1E,NPSAV
      COMMON /RESRC/ NNRES(500)
      COMMON /RESRC2/ LFNUM,MFARF,MMRES,MXRES,NNRSC,NNRSN
      DIMENSION XNRES(500)
      EQUIVALENCE (NNRES(1),XNRES(1))
      COMMON /QVAR/ NFTBU(999),NREL(999),NRELP(999),NREL2(999),
     1NTC(999),PARAM(100,4)
      COMMON /QVAR2/ NDE,NRUN,NRUNS,TBEG,TNOW
      COMMON /PARM/ ISTRM,JTRIB(6),NPRMS,IPAR(100),SCALE,IISED(10),SSEED
     1(10)
      DIMENSION ATRIB(6)
      EQUIVALENCE (ATRIB(1),JTRIB(6))
      COMMON /FILES/NSET(7000)
      COMMON /FILES2/NNVNT(4500)
      COMMON /FILES3/MFEE,MFAE,MMID,MLEE,JJPTR,JJPAC,EEVTI
      DIMENSION QSET(7000), EEVNT(4500)
      EQUIVALENCE (NSET(1),QSET(1)), (NNVNT(1),EEVNT(1))
      COMMON /STAT/ JCELS(200,20),JSINK(200),NBRKB,NBRKS,NCLCT,NDT,NDTL,
     1NDTU,NHIST,NPD,NQL,NQU,NSINK(200),NSKS,NSKSR,NSKST,NSNR(200),SNODE
     2(200),SUMA(200,7),WIDTH(200),XLOW(200),XSTUS(200)
      COMMON /QUE/ BLMAX(100),BSMAX(100),BSMIN(100),
     1IMNG(50),MAXQS,MAXNS,MFAQ,
     2MFAS,MFEQ(50),MLEQ(50),MFESO(50),NABA(280),NPO(100),NPTR(999),
     3NQAT(999),NON,NSAQ(100),NSERE,NSETS(100),NSN,NSTUS(50),QMAX(50),
     4QMIN(50),SBLK(50),SBUS(50),SQUE(50),TLCB(50),TLCQ(50),XBALK(50),
     5NSAC2(50),LABLS(50,2)
      DIMENSION XABA(280)
      EQUIVALENCE (NABA(1),XABA(1))
      COMMON /NODAL/LSINK(999),MFE(999),MFEB(999),NDCH(999,2),NDPT(999),
     1 NSIGN(999),NTYPE(999),LABLN(200,2)
      COMMON /NODAL2/ ID,IM,IMM,MFA,MX,MXX,NN,NOQ
      COMMON /TRANS/ DESCR(4500)
      COMMON /TRANS2/KNOD,MFAD,NDPTP,NDSTR(600)
      DIMENSION XDSTR(600), NESCR(4500)
      EQUIVALENCE (NESCR(1),DESCR(1)), (XDSTR(1),NDSTR(1))
      COMMON /MXDIM/ MXABA,MXCEL,MXNOD,MXNPO,MXPAR,MXQUE,MXSOU,MXSTA,MXT
     1RS,MXVAS,MAXDS,MXNS2,MXNTR,MXSER,MXSTR,RMXVA,MXEVT
      COMMON /GENL/ IFIN,IFPST,ISMRY,ITRAC,LIST80,MON,NAME(12),NCRDR,NDA
     1Y,NNM,NPRNT,NPROJ(12),NSORC(20),NTRCS,NTRCE,NSRC,NYR,TTFIN
      COMMON /FFI/ KARD(80),IRSULT(50),RSULT(50),IALPHA(8,50),NCOMMA,ICO
     1NT,IFLAG(50)
      DIMENSION XALPHA(8,50)
      EQUIVALENCE (XALPHA(1,1),IALPHA(1,1))
      COMMON /ERRFLG/ KOUNTF,KOUNTW,NPRNT2,NPRNTS
      COMMON /MACOM/ IKARD(80),LLMAC,LLCRD,MACNO,MACNN(999),MACAN(100),M
     1ATBU,MMCOM,MMCRD,MMPAK,MNTBU,MXAFM,MXNFM,NPPNT4,LABLM(150),MXNMC
      COMMON /STRAC/ KTRAC,NPRNT3,NNPTS,KTRCE,KTRCS,NTBTR(50)
      COMMON /MULTS/ MSTUS(200),MMOE
      COMMON /USTAT/ UOBV(100,5),NUCOL,MUCOL,LLCOL(100,2),UTPV(100,6),
     1NUTIM,MUTIM,LLTIM(100,2),INCEL(100),IJCEL(500),UMLOW(100),UMWID
     2(100),LLMIS(100,2),NUMIS,MUMIS,UTCLR(100)
      COMMON /EVNTS/ IODEV
  END
```

F-4. SUBROUTINE UF

```
      FUNCTION UF(MM)
      INCLUDE PROC1
      COMMON /USER/  CUMP(5,12),VLU(5),SENPAR(4,12),SENL(12),NSBCEL,
     1               RATT(6),JATCNT,VECTOR(5),CONPAR(12),MAXIDF,MAXACA,
     2               XNINCO(12),XINFAC(3),RPTA(36),FACA(6)
     3               ,NOCONF(4,12),CLEMCY,MONTHS
      REAL NO
      GO TO (1,2,3,4,5,6,7),MM
    1 CONTINUE
C     ************************************************************
C     **** GENERATE PROBABILITY THAT A PARTICULAR TRANSACTION  WILL ****
C     **** GO TO A SPECIFIC  LEVEL OF COURT MARTIAL AND RETURN      ****
C     **** COURT MARTIAL LEVEL AS ATTRIBUTE 2.                      ****
C     ************************************************************
      RAT1 = GATRB(1)
      IAT1 = RAT1
      DO 9 I = 1,5
         VECTOR(I) = CUMP(I,IAT1)
    9 CONTINUE
      SAMP = DPROB(VECTOR,VLU,5,1)
      UF = SAMP
      RETURN
    2 CONTINUE
C     ************************************************************
C     ****      GENERATE SENTENCE LENGTH AND AWARD AS ATTRIBUTE 3   ****
C     ************************************************************
      RAT1 = GATRB(1)
      RAT2 = GATRB(2)
      IAT1 = RAT1
      IAT2 = RAT2
      XX = DRAND(2)
C     ************************************************************
C     **** CALCULATE PROBABILITY OF NO CONFINEMENT SENTENCE AT TRIAL****
C     ************************************************************
      IF (XX.GT.NOCONF(IAT2,IAT1))GO TO 11
      UF = 0.0
      RETURN
   11 CONTINUE
      KPAR = SENPAR(IAT2,IAT1)
C     ************************************************************
C     ****      CRIME TYPES 1 THRU 12 FOLLOW A NORMAL DISTRIBUTION  ****
C     ************************************************************
      SAMP = NO(KPAR)
      UF  =  SAMP
      RETURN
    3 CONTINUE
C     ************************************************************
C     ****    ASSIGN A UNIQUE NUMBER TO EACH TRANSACTION AND AWARD  ****
C     ****    NUMBER AS ATTRIBUTE 4.                                ****
C     ************************************************************
      JATCNT = JATCNT + 1
      UF  =  JATCNT
C     ************************************************************
C     ****    SEND A "TIMING" TRANSACTION TO PRISON "SUB-CELL" AND  ****
C     ****    AWARD CELL NUMBER AS ATTRIBUTE 5.                     ****
C     ************************************************************
      CALL GETAT(RATT)
      RATT(4) = UF
      KK = NSBCEL - 1
      DO 20 I = 1 ,KK
         J = I + 1
         IF (RATT(3).LT.SENL(J)) GO TO 21
   20 CONTINUE
      J = J + 1
   21 CONTINUE
      K = (J + 39)
      RATT(5) = K
      RATT(3) = TNOW - TMARK(IDUM)
      CALL PTIN(K,0.0,TNOW,RATT)
      L = J - 1
C     ************************************************************
C     **** COLLECT STATISTICS FOR NUMBER IN SENTENCE LENGTH         ****
C     **** AND FACILITIES        (IDF'S / USACA / USADB )           ****
C     ************************************************************
      IF (L.LE.MAXIDF) K = 1
      IF ((L.GT.MAXIDF).AND.(L.LE.MAXACA)) K = 2
      IF (L.GT.MAXACA) K = 3
      M = K + 12
      XNINCO(L) = XNINCO(L) + 1.
      CALL TIM(XNINCO(L),L)
      XINFAC(K) = XINFAC(K) + 1.
```

```
      CALL TIM(XINFAC(K),M)
  121 CONTINUE
      RETURN
    4 CONTINUE
C     ****************************************************************
C     ****  BASED UPON APPROVED SENTENCE (ATTRIBUTE 3), CALCULATE   ****
C     ****  ACTUAL TIME TO BE SERVED AND SUBTRACT WAITING TIME IF   ****
C     ****  TRANSACTION HAS BALKED.                                 ****
C     ****************************************************************
      TLM = TMARK (IDUM)
      AT3 = GATRB(3)
      TMCHK = TNOW
      IF(AT3.LE.12.0) GO TO 33
      XX = DRAND(2)
      IF(XX.GT.CLENCY) GO TO 33
      IF(AT3.GT.36.0) GO TO 32
      XMN = (AT3 -6.)/3 + 6.0
      SENTCE = -XMN * ALOG(DRAND(5))
      IF(SENTCE.LT.6.) SENTCE = 6.
      GO TO 34
   32 CONTINUE
      XMN = (AT3 -12.)/3 + 12.0
      SENTCE = -XMN * ALOG(DRAND(5))
      IF(SENTCE.LT.12.) SENTCE = 12.
      GO TO 34
   33 CONTINUE
      DO 30 IJ = 2,NSBCEL
         II =IJ - 1
         IF(AT3.LT.SENL(IJ)) GO TO 31
   30 CONTINUE
      II = II+1
   31 LPAR = CONPAR(II)
      SENTCE = EX(LPAR)
   34 CONTINUE
      IF(SENTCE.GT.AT3) SENTCE = AT3
      UF = SENTCE
      IF(TLM.GE.TMCHK) RETURN
      WTIM = TMCHK - TLM
      UF = SENTCE - WTIM
      IF(UF.LT.0.0)UF = 0.0
      RETURN
    5 CONTINUE
C     ****************************************************************
C     ****  CALCULATE TIME REMAINING ON    NTENCE FOR BALKERS FROM   ****
C     ****  USACA AND USDB.  AWARD REMAI  NG TIME AS ATTRIBUTE 5.   ****
C     ****************************************************************
      AT3 = GATRB(3)
      TLM = TMARK(IDUM)
      TMCHK = TNOW
      TIMLFT = (AT3 + TLM) - TMCHK
      UF = TIMLFT
      RETURN
    6 CONTINUE
      CALL GETAT(RATT)
      NOFQ = RATT(5)
      AT3  = RATT(3)
      I = NOFQ - 40
      WT = TNOW - TMARK(IDUM) + AT3
      CALL COL(WT,I)
      IF (I.LE.MAXIDF) J = 13
      IF ((I.GT.MAXIDF).AND.(I.LE.MAXACA))J = 14
      IF (I.GT.MAXACA) J = 15
      CALL COL(WT,J)
      IF (I.LE.MAXIDF) K = 1
      IF ((I.GT.MAXIDF).AND.(I.LE.MAXACA)) K = 2
      IF (I.GT.MAXACA) K = 3
      M = K + 12
      XNINCO(I) = XNINCO(I) - 1.
      CALL TIM(XNINCO(I),I)
      XINFAC(K) = XINFAC(K) - 1.
      CALL TIM(XINFAC(K),M)
   61 CONTINUE
      UF = NOFQ
      RETURN
    7 CONTINUE
      IF (TNOW.LT.TBEG) GO TO 56
      MONTHS = MONTHS + 1
   56 CONTINUE
      UF = 1.0
      RETURN
      END
```

F-5. SUBROUTINE UI

```
      SUBROUTINE UI
      INCLUDE PROCI
      COMMON /USER/  CUMP(5,12),VLU(5),SENPAR(4,12),SENL(12),NSBCEL,
     1               RATT(6),JATCNT,VECTOR(5),CONPAR(12),MAXIDF,MAXACA,
     2               XNINCO(12),XINFAC(3),RPTA(36),FACA(6)
     3               ,NOCONF(4,12),CLEMCY,MONTHS
C
C
      JATCNT = 0
C
      DO 120 I = 1,12
         XNINCO(I) = 0.0
  120 CONTINUE
      DO 140 I = 1,3
         XINFAC(I) = 0.0
  140 CONTINUE
C
C
      IF (NRUN.GT.1) GO TO 600
C
      NSBCEL = 12
C
C
      MONTHS = 0
C
C
      DATA VLU / 1., 2., 3., 4., 5./
C
C
      DATA SENL / 00.033, 01.033, 02.033, 03.033, 06.033, 12.033,
     1            15.033, 18.033, 24.033, 36.033, 60.033,120.033/
C
      DATA RPTA  /4H 0- ,4H1 MO,4HNTH ,4H 1- ,4H2 MO,4HNTHS,
     1            4H 2- ,4H3 MO,4HNTHS,4H 3- ,4H6 MO,4HNTHS,
     2            4H 6-1,4H2 MO,4HNTHS,4H12-1,4H5 MO,4HNTHS,
     3            4H15-1,4H8 MO,4HNTHS,4H18-2,4H4 MO,4HNTHS,
     4            4H 2- ,4H3 YE,4HARS ,4H 3- ,4H5 YE,4HARS ,
     5            4H 5-1,4H0 YE,4HARS ,4H10+ ,4H  YE,4HARS /
C
      DATA FACA  /4H    ,4H IDF,4H   U,4HSACA,4H   U,4HSDG /
C
C
   10 FORMAT (10X,5(F5.2))
   20 FORMAT(10X,4(F5.2))
   30 FORMAT(10X,4(F4.0))
   40 FORMAT(7X,F5.3)
   50 FORMAT(10X,12(F4.0))
   60 FORMAT(7X,I2)
C          CUMULATIVE PROBABILITY INPUT DATA READ STATEMENT
C          J(1)=SUM CM, J(2)=SPC CM, J(3)=BCD CM, J(4)=GEN CM, J(5)=NO CM
      DO 100 I = 1,12
         READ(5,10)(CUMP(J,I),J =1,5)
  100 CONTINUE
C          PROBABILITY OF NO CONFINEMENT FOR EACH CRIME TYPE
C          J(1)=SUM CM, J(2)=SPC CM, J(3)=BCD CM, J(4)=GEN CM
      DO 200 I = 1,12
         READ(5,20)(NOCONF(J,I),J = 1,4)
  200 CONTINUE
C          SENTENCING PARAMETER INPUT DATA READ STATEMENT
C          J(1)=SUM CM, J(2)=SPC CM, J(3)=BCD CM, J(4)=GEN CM
      DO 300 I = 1,12
         READ(5,30)(SENPAR(J,I),J = 1,4)
  300 CONTINUE
C          CLEMENCY FACTOR FOR REDUCING SENTENCE
      READ(5,40) CLEMCY
  400 CONTINUE
C          CONVICTION PARAMETER INPUT DATA READ STATEMENT
      READ(5,50) CONPAR
  500 CONTINUE
C          UPPER LIMIT SENTENCE CATEGORY FOR CONFINEMENT TO IDF
C          UPPER LIMIT IS ONE MONTH
      READ(5,60) MAXIDF
C          UPPER LIMIT SENTENCE CATEGORY FOR CONFINEMENT TO USACA
C          UPPER LIMIT IS TWELVE MONTHS
      READ(5,60) MAXACA
  600 CONTINUE
      RETURN
C
      END
```

F-6. SUBROUTINE UO

```
      SUBROUTINE UO
      INCLUDE PPOC1
      COMMON /USER/ CUMP(5,12),VLU(5),SENPAR(4,12),SENL(12),NSBCEL,
     1              RATT(6),JATCNT,VECTOR(5),CONPAR(12),MAXIDF,MAXACA,
     2              XNINCQ(12),XINFAC(3),RPTA(36),FACA(6)
     3              ,NOCONF(4,12),CLEMCY,MONTHS
      IIFLG = 0
    1 CONTINUE
      IF (IIFLG.EQ.0) GO TO 2
      WRITE (NPRNT,104)
      GO TO 3
    2 CONTINUE
      WRITE (NPRNT,101) NRUN
      IFC = 1
      ILC = 12
    3 CONTINUE
      DO 10 J = IFC,ILC
          L = (J - IFC)*3 +1
          K = (J - IFC)*2 +1
          IF (UOBV(J,3)) 4,5,6
    4     CALL ERORZ (20)
    5     IF (IIFLG.EQ.0) WRITE (NPRNT,103) RPTA(L),RPTA(L+1),RPTA(L+2)
          IF (IIFLG.EQ.1) WRITE (NPRNT,106) FACA(K),FACA(K+1)
          GO TO 10
    6     XS=UOBV(J,1)
          XSS=UOBV(J,2)
          XN=UOBV(J,3)
          AVG=XS/XN
          NXN=XN+.00001
          IF (NXN-1) 7,7,8
    7     STD=0.
          GO TO  9
    8     YSS=XSS-XS*XS/XN
          IF (YSS.LE.0.0) GO TO 7
          STD=SQRT(YSS/(XN-1.0))
    9     STDM=STD/SQRT(XN)
          IF (IIFLG.EQ.0) WRITE (NPRNT,109) RPTA(L),RPTA(L+1),RPTA(L+2),
     1    AVG,STD,STDM,UOBV(J,4),UOBV(J,5),NXN
          IF (IIFLG.EQ.1) WRITE (NPRNT,110) FACA(K),FACA(K+1),AVG,STD,
     1    STDM,UOBV(J,4),UOBV(J,5),NXN
          CALL COLC(J)
   10 CONTINUE
      IF (IIFLG.EQ.1) GO TO 11
      IFC = 13
      ILC = 15
      IIFLG = 1
      GO TO 1
   11 CONTINUE
      IFC = 0
      ILC = 0
      IIFLG = 0
      KKFLG = 0
   12 CONTINUE
      T = TNOW
      IF (IIFLG.EQ.0) GO TO 13
      WRITE (NPRNT,108)
      WRITE (NPRNT,112)
      GO TO 14
   13 CONTINUE
      WRITE (NPRNT,107)
      WRITE (NPRNT,111)
      IFC = 1
      ILC = 12
   14 CONTINUE
      DO 18  J = IFC,ILC
          K = (J - IFC)*2 + 1
          L = (J - IFC)*3 + 1
          IF (UTPV(J,3)-UTCLR(J)) 15,16,17
   15     CALL ERORZ (16)
   16     IF (IIFLG.EQ.0)WRITE (NPRNT,103) RPTA(L),RPTA(L+1),RPTA(L+2)
          IF (IIFLG.EQ.1)WRITE (NPRNT,106) FACA(K),FACA(K+1)
          GO TO 18
   17     XS=UTPV(J,1)+UTPV(J,6)*(T-UTPV(J,3))
          XSS=UTPV(J,2)+UTPV(J,6)*UTPV(J,6)*(T-UTPV(J,3))
          XT=T-UTCLR(J)
          AVG=XS/XT
          STD=(XSS/XT-AVG*AVG)
          IF (STD.LT.0.0) STD=0.0
          STD=SQRT(STD)
          IF (IIFLG.EQ.0)WRITE (NPRNT,102) RPTA(L),RPTA(L+1),RPTA(L+2),
     1AVG,STD,UTPV(J,4),UTPV(J,5),MONTHS
```

```
         IF (IIFLG.EQ.1)WRITE (NPRNT,105) FACA(K),FACA(K+1),
     1AVG,STD,UTPV(J,4),UTPV(J,5),MONTHS
   18 CONTINUE
      IF(IIFLG.EQ.1)GO TO 26
      IFC = 13
      ILC = 15
      IIFLG = 1
      GO TO 12
   26 CONTINUE
      CALL CCLC (0)
      CALL TIMC (0)
      MONTHS = 0
C
C
      RETURN
C
C
  101 FORMAT (1H1///44X,34H***** RESULTS BASED ON SIMULATION ,I3,6H ****
     1*,///,35X,61H**** CONFINEMENT TIME SERVED BY SENTENCE LENGTH CATEG
     2ORY ****,///,6X,8HSENTENCE,10X,13HAVE CONF TIME,10X,7HSTD DEV,10X,
     39HSD OF AVE,10X,7HMINIMUM,11X,7HMAXIMUM,10X,9HNO OF OBS,/,6X,8HCAT
     4EGORY,13X,8H(MONTHS),//)
  102 FORMAT (4X,3A4,10X,F8.4,12X,3(F8.4,10X),I5,/)
  103 FORMAT (4X,3A4,7X,18HNO VALUES RECORDED,/)
  104 FORMAT (/////39X,54H**** CONFINEMENT TIME SERVED AT SPECIFIC FACIL
     1ITY ****,///,5X,11HCONFINEMENT,9X,13HAVE CONF TIME,10X,7HSTD DEV,
     210X,9HSD OF AVE,10X,7HMINIMUM,10X,7HMAXIMUM,10X,9HNO OF OBS,/,6X,8
     3HFACILITY,13X,8H(MONTHS),//)
  105 FORMAT (5X,2A4,12X,F8.4,13X,3(F8.4,10X),I5,/)
  106 FORMAT (5X,2A4,12X,18HNO VALUES RECORDED,/)
  107 FORMAT (1H1///24X,63H***** AVERAGE DAILY PRISONER POPULATIONS WITH
     1IN EACH SENTENCE LENGTH CATEGORY *****,///)
  108 FORMAT (///33X,66H***** AVERAGE DAILY PRISONER POPULATION AT SPECI
     1FIC FACILITY *****,///)
  109 FORMAT (4X,3A4,10X,F8.4,12X,4(F8.4,10X),I5,/)
  110 FORMAT (5X,2A4,12X,F8.4,13X,4(F8.4,10X),I5,/)
  111 FORMAT (6X,8HSENTENCE,12X,9HAVE DAILY,12X,7HSTD DEV,10X,
     17HMINIMUM,11X,7HMAXIMUM,9X,12HNO OF MONTHS,/,6X,8HCATEGORY,1
     22X,10HPOPULATION,64X,10HSUMMARIZED,///)
  112 FORMAT (5X,11HCONFINEMENT,11X,9HAVE DAILY,12X,7HSTD DEV,10X,
     17HMINIMUM,11X,7HMAXIMUM,9X,12HNO OF MONTHS,/,6X,8HFACILITY,
     213X,10HPOPULATION,64X,10HSUMMARIZED,///)
C
C
C
C
C
      END
```

GLOSSARY

1. ABBREVIATION, ACRONYMS, AND SHORT TERMS

ACS	Army Correctional System
ACSS	Army Correctional System Study
AP3	Army Prisoner Population Prediction Study
AR	Army regulation
BCD	bad conduct discharge
CAA	US Army Concepts Analysis Agency
CONUS	Continental United States
DCSPER	Deputy Chief of Staff for Personnel
EEA	essential element(s) of analysis
FORTRAN	a computer programing language
GCM	general court-martial
IDF	installation detention facility
JAG	Judge Advocate General
MCM	Manual for Courts-Martial
MPOA	Military Police Operations Agency
OALE	Office of Army Law Enforcement
OCONUS	outside of the Continental United States
ODCSPER	Office of the Deputy Chief of Staff for Personnel
POM	program objective memorandum
SCM	summary court-martial
SPCM	special court-martial

SPCM-BCD	special court-martial empowered to adjudge a bad conduct discharge
TJAG	The Judge Advocate General
USACA	United States Army Correctional Activity
USALSA	United States Army Legal Services Agency
USAREUR	United States Army, Europe
USDB	United States Disciplinary Barracks

2. MODELS, ROUTINES, AND SIMULATIONS

PRISM	The Army Prisoner Management Model
PROC1	a PROCEDURE containing the DIMENSION and COMMON statements for expanding Q-GERT
Q-GERT	Queuing Systems - Graphical Evaluation and Review Technique: a simulation language made up of FORTRAN subroutines
QGERT	the main program for Q-GERT containing the size specifications for Q-GERT
UF	User Function; a subroutine written for Q-GERT to prescribe actions within PRISM
UI	User Input; a subroutine written to adapt model user input for PRISM
UO	User Output; a subroutine written to define and specify the output management reports for PRISM

[illegible] POPULATION [illegible] STUDY	ONE SHEET STUDY GIST [illegible]

[illegible] of the work reported herein are as follows:

[illegible] is assessing the impact of [illegible] and various confinement [illegible] workloads.

[illegible] substantial increases or [illegible] impact:

[illegible] to refer an offender to [illegible] offender by non-judicial or [illegible]

[illegible] the work reported herein rests are [illegible]

[illegible] to exist.

[illegible] continue to exist [illegible]

[illegible] affect the findings [illegible]

[illegible] input derivation are [illegible] rather than empirical [illegible]

[illegible] confinements were not available for [illegible]

[illegible] prisoners in Army facilities were not [illegible]

[illegible] for individual offenses were based [illegible] for which an accused was convicted.

[illegible] only Army enlisted populations.

[illegible] criminal justice system [illegible] included assessment [illegible] reliable, valid [illegible] of courtle- [illegible]

[illegible] described as [illegible] of the [illegible]

[illegible]

END

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